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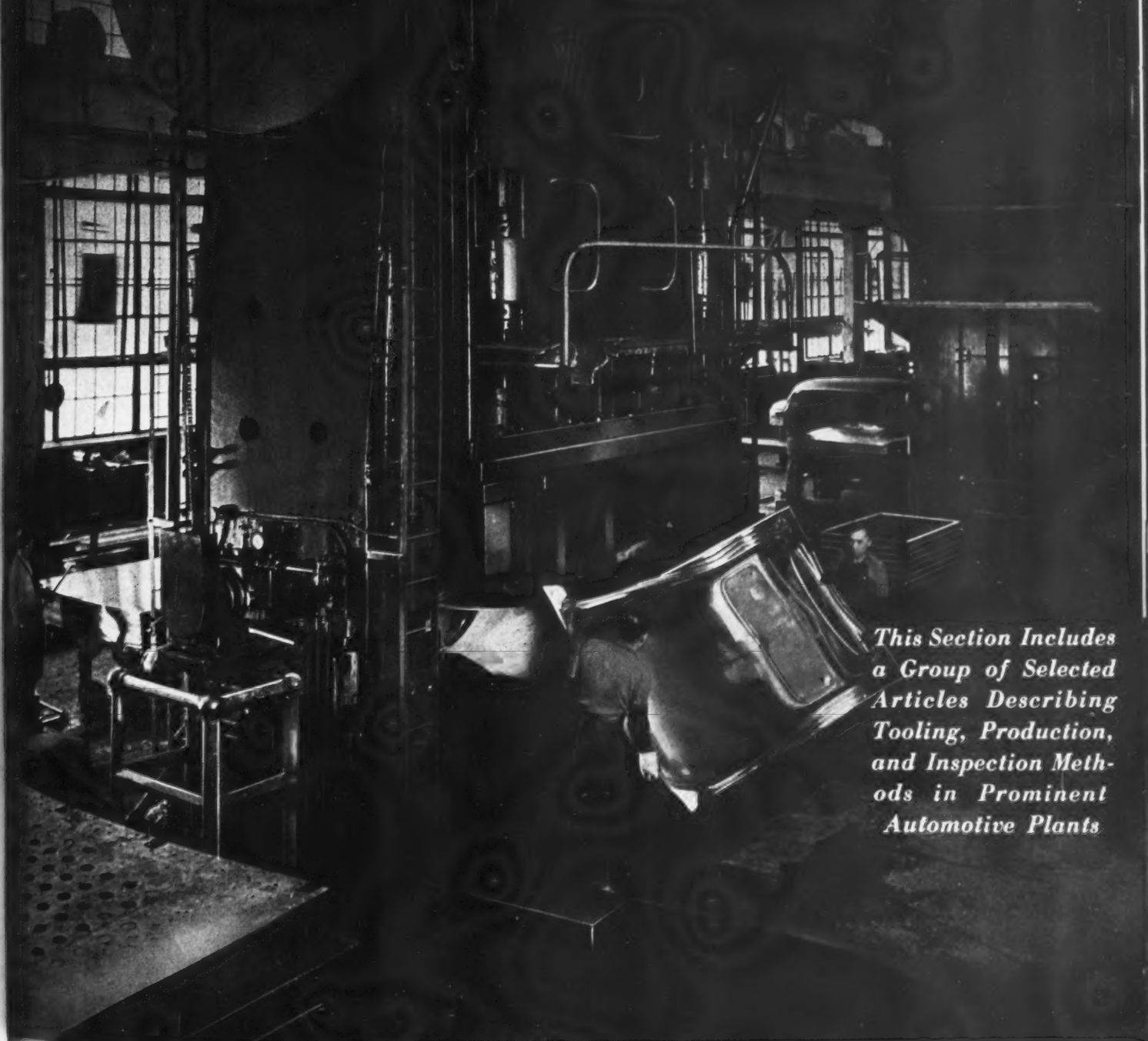
Tool Engineering in the Automotive Industry



This Section Includes a Group of Selected Articles Describing Tooling, Production, and Inspection Methods in Prominent Automotive Plants

The Importance of the Tool Engineer

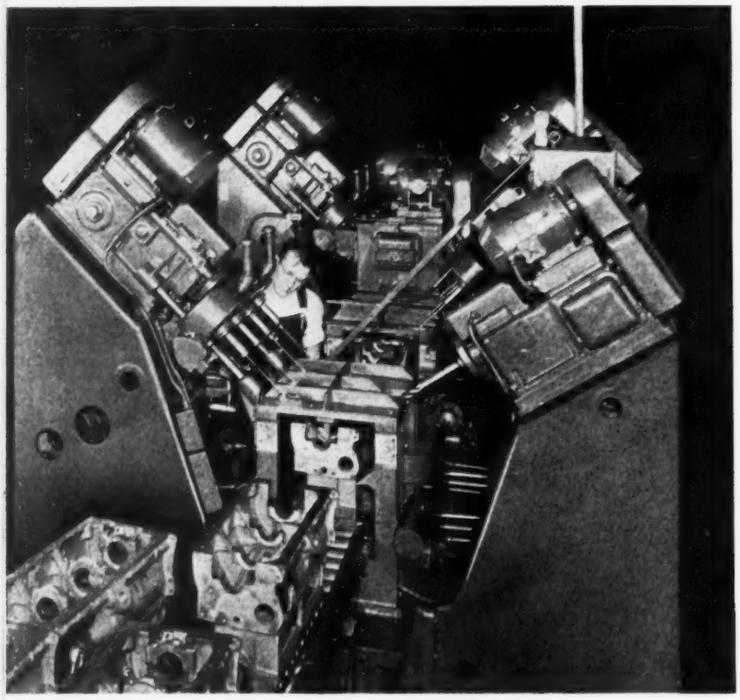
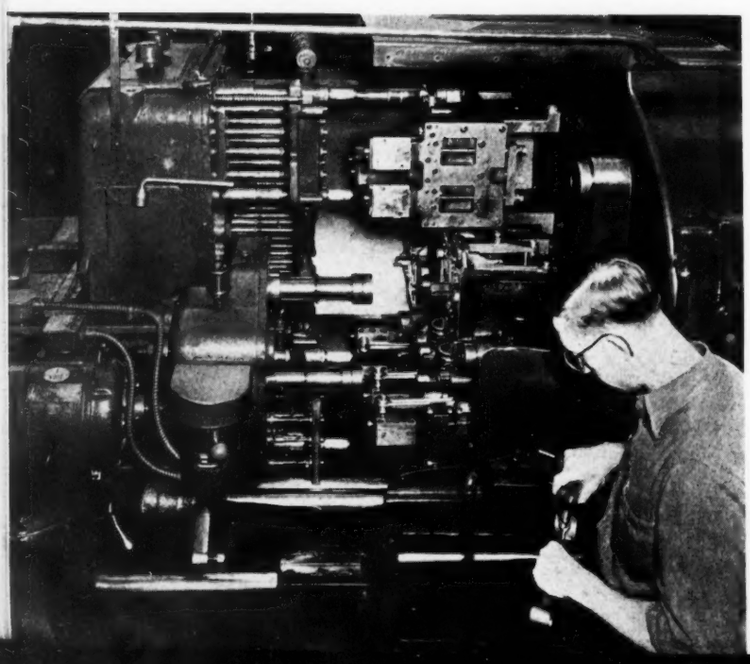


Fig. 1. Special Machine which Automatically Indexes Cylinder Blocks and Clamps Them for Drilling and Tapping

Fig. 2. Ingenious Tooling is a Feature of This Special Machine, Built for Finishing the Bolt Holes in Connecting-rods and Caps



By CHARLES O. HERB

TOOL engineering became of vital importance to all branches of the metal-working industry with the application of the principles of mass production. Wherever parts are being made in large quantities, special tooling arrangements must be devised to meet peculiar problems or to attain maximum efficiency of machines and men.

Even a standard machine can seldom be installed in a production line without careful attention being first given to the tooling that must be provided before the machine can be placed in operation. Special broaches or multiple-spindle drill heads may have to be designed to meet the individual need, and, nearly always, jigs or fixtures to insure interchangeability and speed up production.

On the other hand, entirely special machines are frequently justified because of manufacturing advantages—machines that become obsolete with radical changes in the design of the work. Special machines of this type, however, should be built only when there are definite indications that the machines will pay for themselves before they have to be discarded. Within recent years many special machines have been constructed from standard bases, tables, hydraulic heads, etc., that can be rearranged into other machines when changes in product design make them unsuitable for their original purpose.

The highly important work of tooling up standard machines and of designing special machines, tools, jigs, and fixtures has become the duty of the tool engineer. Upon his ingenuity in planning production methods depends the efficiency not only of individual machines but of entire shops. In addition, the tool engineer generally has an important influence in the selection of new machinery and tools. Throughout industry, the reputation of a plant for high manufacturing efficiency can be traced directly to the competence of its tool engineering department.

All tool engineers, however, are not employed in production plants. Many of them are found in the drafting-rooms of machine-building concerns and tool shops engaged in designing equipment for use in production shops. Some men who were trained as tool engineers have become particularly successful sales engineers because of their ability to make

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intelligent suggestions to the buyer and to offer constructive criticism on tooling proposals.

During the month of March the Annual Meeting and Exposition of the American Society of Tool Engineers will be held in Detroit. Coincidental with this meeting, MACHINERY is presenting a number devoted to tooling, production, and inspection methods used in some of the principal plants in the automotive industry, which is, of course, outstanding in the application of high-production methods. This, the first article, illustrates examples of unique tooling selected from a number of plants.

The new truck engine plant of the International Harvester Co., Indianapolis, Ind., has a considerable number of special machines designed to obtain maximum production by performing a multiple number of operations. One of the outstanding machines in this class is that built by the W. F. & John Barnes Co. for drilling and tapping a large number of holes in cylinder blocks. In this machine, shown in Fig. 1, each cylinder block is automatically located and clamped in three stations, to which it is automatically indexed. In each indexed position, multiple-spindle heads are advanced for drilling or tapping. If any one clamp or spindle should fail to operate in the proper sequence, the entire machine would stop automatically.

In Fig. 2 is shown a machine built by Greenlee Bros. & Co. for drilling, reaming, counterboring, and spot-facing the bolt holes in connecting-rods and their caps. The connecting-rods and caps must be placed in different positions in the successive stations of the indexing fixture, and they are carried several times around the machine.

Malleable-iron differential cases, such as seen at the front of the machine in Fig. 3, are made in the Axle Division of the Eaton Mfg. Co., Cleveland, Ohio, with a spherical seat that must be precision-bored to obtain the high degree of finish and accuracy required. This spherical seat must have a radius between 2.377 and 2.379 inches. The surface has been rough- and finish-machined when it comes to the Heald machine illustrated, which is equipped with a special chuck in which the case is seated on a large-diameter locating surface. The part is clamped on this seat by means of a hydraulic ram which revolves with the chuck and work.

After the work has been located and the machine started, the table feeds forward to bring a tungsten-carbide tool in holder *A* into the cutting posi-

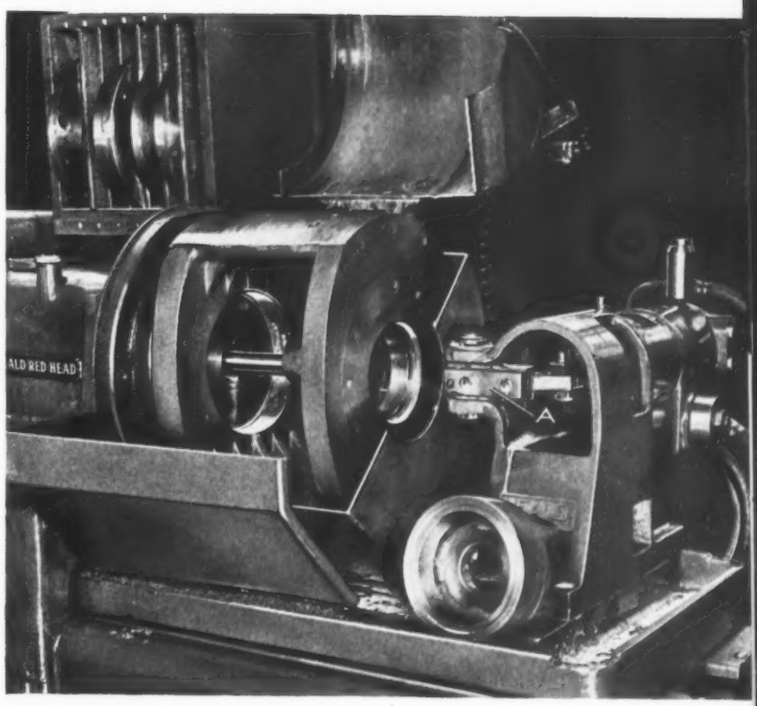


Fig. 3. Ingenious Tooling Arrangement Developed for the Spherical Boring of Eaton Differential Cases

Fig. 4. Rotary Milling Machine Arranged for Finishing a Large Number of Surfaces on Tractor Manifolds and Housing Covers

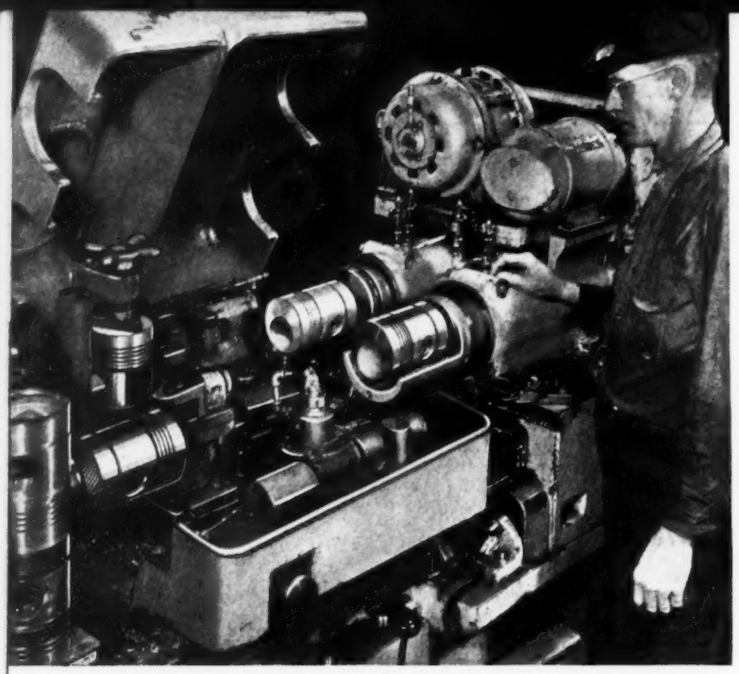


Fig. 5. Four-station Precision Boring and Turning Machine in which Tractor Pistons are Finish-turned, Grooved, Bored, and Faced

tion, at which point the table stops. Then holder *A* is swiveled on a vertical post to carry the tool across the work at the desired radius. Stock to a depth of from 0.008 to 0.014 inch is removed.

When the cut is completed, the table is reversed and the tool withdrawn without marring the finished surface. Swiveling of the tool-holder is accomplished through the movement of a crank, which is actuated by a hydraulic cylinder on the tool-head. Oil is admitted into this cylinder when the table strikes a dog at the end of its forward movement, and is released when the table returns.

A Newton rotary milling machine arranged for obtaining maximum production when the quantity of work required is not sufficient to keep the machine busy on one job, is illustrated in Fig. 4. The photograph was taken in the new tractor plant of the Allis-Chalmers Mfg. Co., Milwaukee, Wis. Manifolds are rough- and finish-milled in three positions, and housing covers in five positions, there being eight fixtures of different designs on the table. The roughing cutter is fitted with Stellite J-metal blades, and the finishing cutter, with blades of high-speed steel. The operation is continuous.

Maximum use of a single machine seems to be achieved in the operation illustrated in Fig. 5, which shows an Ex-Cell-O precision boring and turning machine taking a variety of finishing cuts on pistons at the Caterpillar Tractor Co., Peoria, Ill. When the pistons reach this machine, they have been rough-machined all over, with the exception of the crater. The crater is finished in the right front position of the machine by a tool mounted in a holder that swings it across the closed face of the piston at the proper radius. The piston is then transferred to the rear position at the right-hand end of the machine, where the ring grooves are finished and the flat portion of the closed end is faced by seven cutters mounted on a slide.

The piston is next transferred to the left front of the machine, where the outside diameter is turned as the table advances toward the left. Then the piston is transferred to the rear left position, where both pin-holes are accurately bored in close alignment. To locate the piston properly for this operation, a bar is passed through the pin-holes and then fingers on the work fixture are swung forward into contact with the bar. With the fingers properly registered, the clamp is tightened on top of the piston, after which the fingers are swung out of the way and the locating bar is removed.

The pin-holes are bored by tools on a spindle mounted in the left-hand head, at the same time that the piston in the left front station is being turned. In the first three stations, the pistons are mounted on the head spindles, while in the last station the piston is mounted on the table.

Precision boring machines have become standard equipment for the accurate finishing of bearings in line, a typical example of this kind being shown in Fig. 6. The operation illustrated, which is performed by a Heald Bore-Matic in the Axle Division of the Eaton Mfg. Co., consists of finishing opposing bores in pinion bearing cages, such as seen at the front of the machine.

Both bores must be finished to from 3.7480 to 3.7485 inches in diameter, and must be in line within 0.0002 inch for their entire length. The dimension from the bottom of each bore to the face

Fig. 6. A Double-head Bore-Matic Employed for the Simultaneous Finishing of Accurate Bores in Pinion Bearing Cages

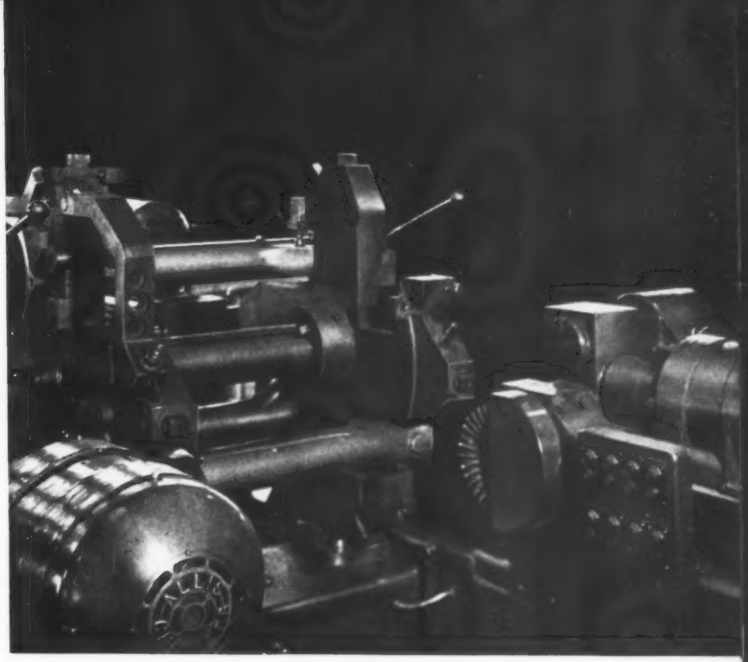


Fig. 7. Front View of a Machine that is Used for the Complete Finishing of Torque-tube Castings for Farm Tractors

of the flange is held within 0.004 inch. Each boring head is provided with two cutters, one of which takes the boring cut and the other a facing cut at the bottom of the bored surface.

The torque-tube casting on Model B tractors built by the Allis-Chalmers Mfg. Co. must be machined accurately because of the fact that it ties the tractor together, the engine being bolted to one end of the casting and the transmission to the other. It was therefore desirable to machine this casting complete in one operation.

This problem was solved by designing the machine illustrated in Figs. 7 and 8, which was built by the Stokerunit Corporation and equipped with three Ex-Cell-O and three Stokerunit hydraulically operated heads. The machine is provided with a four-station indexing fixture. In the front station, shown in Fig. 7, two milling heads on opposite sides of the machine mill the casting to length.

When the casting is indexed to the rear station, shown in Fig. 8, five holes are drilled, one large hole precision-bored for the propeller shaft, and a bearing faced for the propeller shaft by tools on the right-hand head. At the same time, four holes are drilled by the head at the left-hand end of the machine and six holes are drilled by two heads in the left foreground which move forward at right angles to the right- and left-hand heads.

The precision boring cut is taken by a tungsten-carbide tool before the drills of the same head reach the work. The face milling cutter is mounted on the same spindle as the tungsten-carbide boring cutter.

A Newton milling machine of unusual design is employed by the Caterpillar Tractor Co. for milling various surfaces on the crankcase or bottom side of cylinder blocks. This machine is built with two heads which span the base. The work is carried by the table first beneath the cutters of one head and then beneath those of the other head.

In the first step of this operation, the cylinder block is fed past the left-hand head, shown in Fig. 9, which is provided with two cutters that revolve in a horizontal plane for milling the bearing faces to receive the caps, and two cutters that revolve in vertical planes to mill the bearing-lock surfaces. At the same time, a cutter on the front side of the machine mills pads on the angular side of the casting which extend around openings in the cylinder block, as may be seen at the right.

When the table recedes from these cutters, it carries the cylinder block to the opposite milling head which is equipped, as shown in Fig. 13, with a horizontal arbor on which there is a series of cutters for milling all the bearing faces or bosses simultaneously. The table advances until the center line of the bearings coincides with the center line of the cutter-arbor. Then the table stops and the milling head feeds downward. Upon the completion of the cuts, the head rises and the table again feeds toward the left-hand milling head.

A double work fixture is provided on this machine, as the cylinder must be presented lengthwise to the cutters of the left-hand head and crosswise to the cutters of the right-hand head.While one operation is being performed on one fixture, the opposite fixture is being unloaded and loaded.

The application of the broaching process to the finishing of metal parts frequently calls for ingenuity in designing both the broaches and the

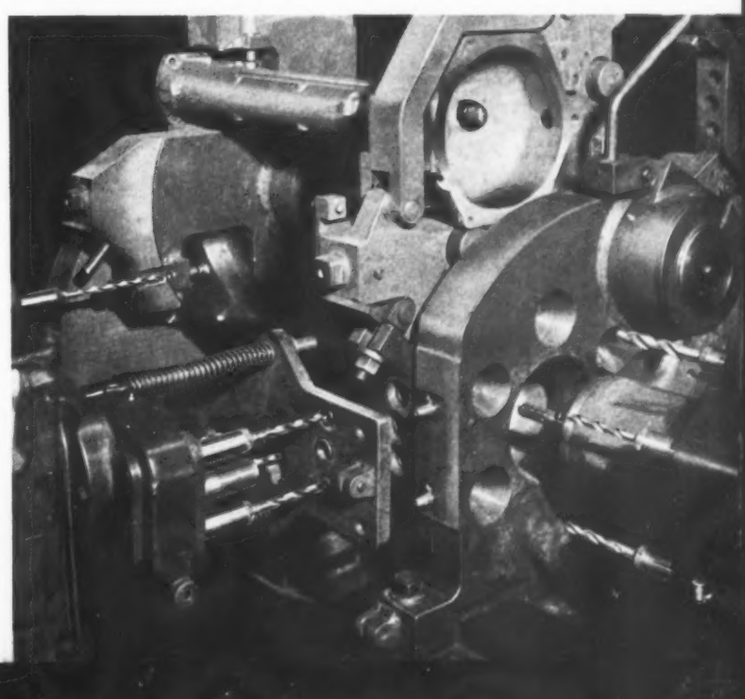


Fig. 8. Another View of the Machine in Fig. 7 which Shows the Arrangement of the Various Drilling and Boring Heads at the Rear

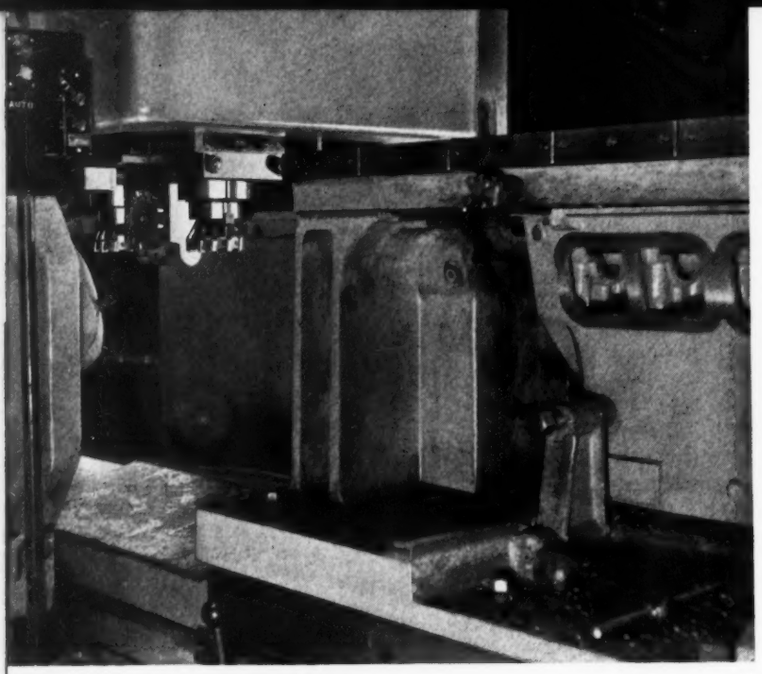


Fig. 9. Left-hand Head of a Double-head Machine Milling Bearing Faces of Cylinder Blocks, Bearing-lock Surfaces, and Pads

work-holding fixtures. Fig. 10 shows a Cincinnati broaching machine used for finishing cylinder-block bearing caps in the new International Harvester truck engine plant. Two caps are mounted in the two stations of each fixture, the work in one of the fixtures being reloaded during the broaching of the parts in the other fixture. Identical broaching tools are provided on both rams of the machine.

The bearing caps in the first station are broached on the sides at the same time that caps in the second station are broached on the half-hole or bore, on the contact faces, and on the ends. The fixtures are swung parallel with the broaches for the operation and away from the broaches for reloading.

Another interesting tooling arrangement in the same shop is the equipment employed for broaching valve tappet holes in the cylinder blocks and pressing the valve guides into holes provided for them above the tappet holes. The machine and tools used for both these operations are shown in Fig. 12. The head of this American broaching machine is hydraulically actuated.

Helical oil-grooves are cut around the outside of idler pinion shafts in the Axle Division of the Eaton Mfg. Co. at the rate of 750 shafts an hour by the use of the ingenious fixture illustrated in Fig. 11. These shafts, which are made of brass rod, are placed upright, one at a time, in holder *A*, and when the ram of the hydraulic press descends, a push-bar attached to the ram forces the pinion shaft downward through an opening in the fixture.

Within the fixture are four cutter bits, mounted in holders such as seen at *B*. These holders can be swiveled by adjusting screws, so as to set the tool bits at predetermined angles. The angular settings of the tool bits cause the shaft to turn as it is forced past them with the result that the groove is cut in a helical path around the shaft.

There are four cutter bits, the two upper ones, on the left- and right-hand sides of the fixture, doing the actual cutting of the groove. The two lower cutter bits, at the front and back, finish the groove and assist in turning the shaft. The shafts

Fig. 10. Broaches and Fixtures Designed for the Simultaneous Machining of Various Surfaces on Crankshaft Bearing Caps

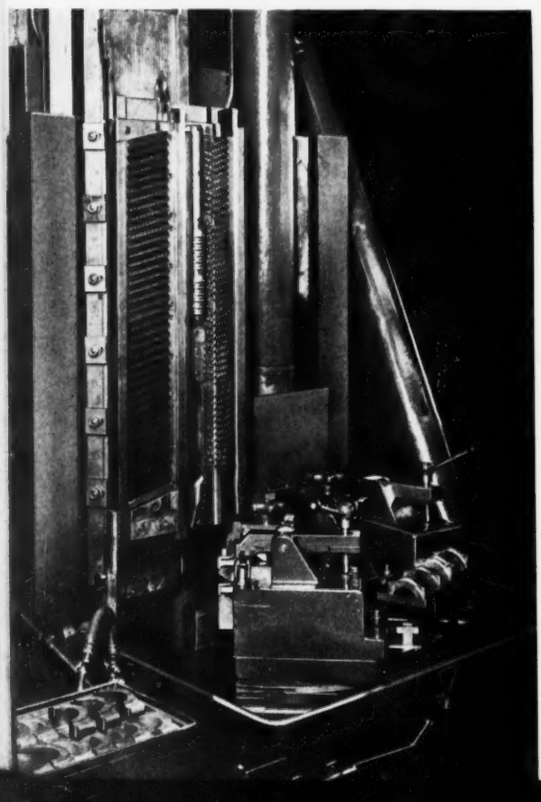


Fig. 11. A Helical Groove is Automatically Cut around Pinion Shafts as they are Forced through This Fixture

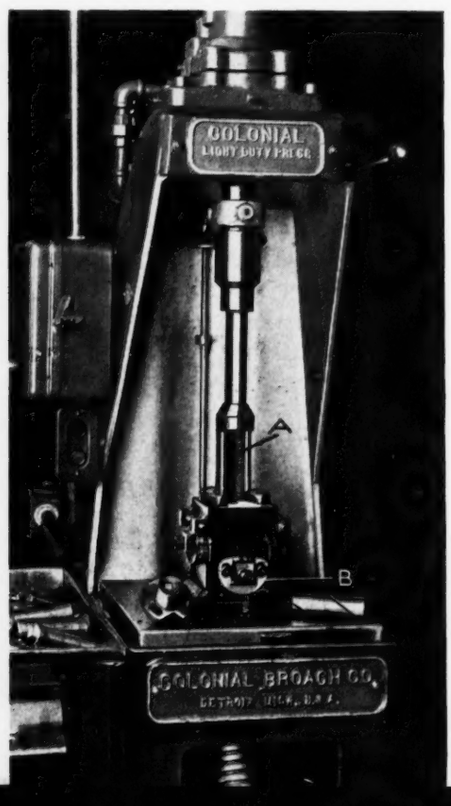


Fig. 12. Equipment Designed for Broaching Valve Tappet Holes in Cylinder Blocks and Pressing in the Valve Guides

are 4 inches long by 1 1/8 inches in diameter, and the groove is cut to a vee about 1/16 inch deep. The push-bar attached to the ram is provided with a ball thrust bearing, so that it is free to turn.

Sometimes the machining of a part of comparatively simple construction necessitates the designing of a jig or fixture that taxes the ingenuity of the tool designer. For example, the scale lever seen in the foreground in Fig. 14 must be held rigidly while a number of holes are being drilled, in order that the center distances between the holes be accurately maintained. It was therefore necessary to design a jig in which the part would be solidly supported at every point where drilling occurs.

The lever is located in this jig on three rounded buttons, and is clamped by three rounded studs, as well as by a set of floating jaws at the right-hand end, as illustrated, which support the work against the drilling and reaming pressure. A stop is tightened against the opposite end of the casting for support. This jig was designed by tool engineers of the Toledo Scale Co., Toledo, Ohio.

A simple but ingenious method of performing two operations simultaneously on a hand milling machine is illustrated in Fig. 15. This machine was originally set up for cutting a Woodruff keyway in a tractor crankshaft; following this operation, it was necessary to countersink a drilled hole in the part. The two operations were combined by mounting a regular portable electric drill on the machine, as shown, so that countersinking can be done simultaneously with the milling of the keyway. This set-up was devised by Allis-Chalmers tool engineers.

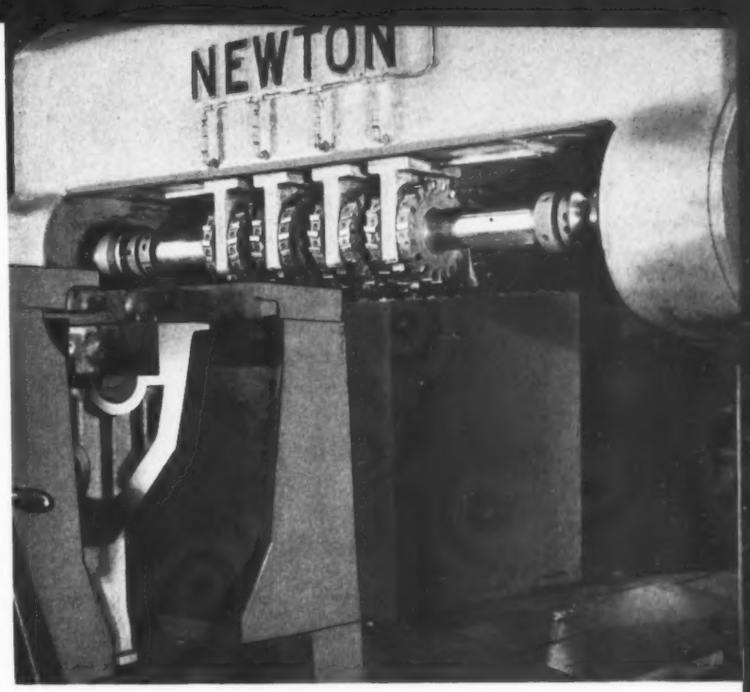


Fig. 13. Right-hand Head of Machine Shown in Fig. 9 which Simultaneously Mills all Bearing Faces or Bosses on Tractor Cylinder Blocks

Considerable time is saved in making changes in the tool set-ups of automatic lathes in the plant just mentioned, by mounting the tools for different jobs on master plates or holders. Then when it is necessary to change the tooling of a machine, the set-up man merely obtains the required master blocks from the tool crib and assembles complete tool units, no adjustment of tools being necessary. Fig. 16 shows a LeBlond lathe with the tools at both front and rear mounted on master plates.

Fig. 14. Open Type of Jig Constructed for Holding a Long Slender Part Rigidly during Drilling Operations

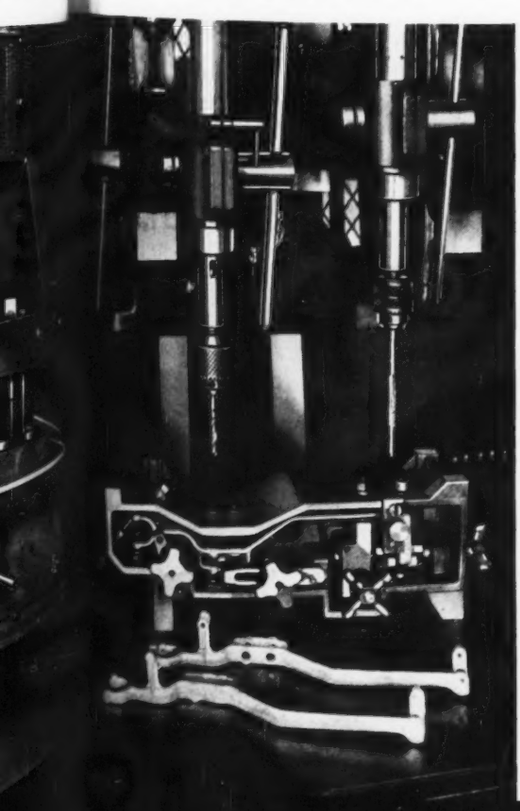


Fig. 15. Two Operations are Combined by Using a Portable Electric Drill on a Standard Hand Milling Machine

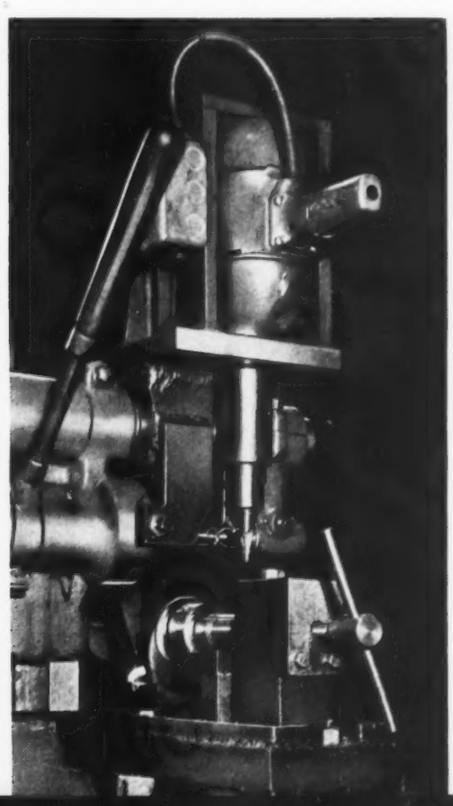
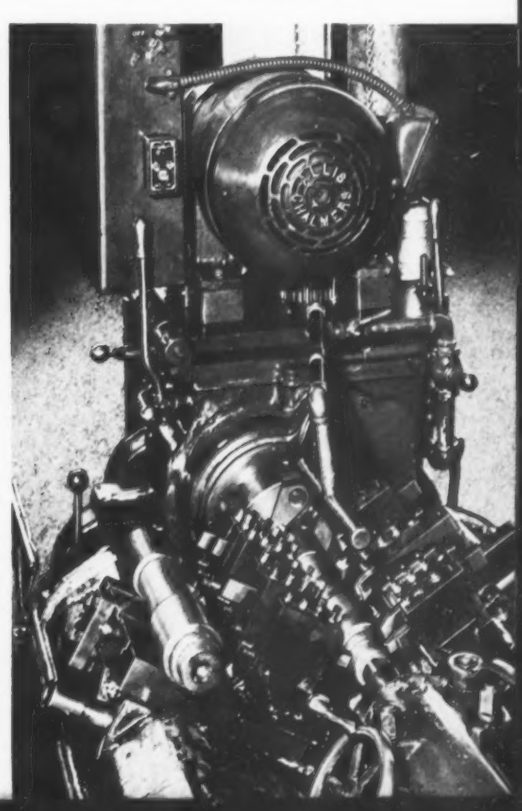


Fig. 16. The Tool Change-over Time of Automatic Lathes has been Reduced by Keeping the Tools Mounted on the Master Plates



Building Caterpillar Tractors

DIFFICULTIES in farming the delta lands of California's San Joaquin and Sacramento Rivers led to the early development of the track type tractor. Men, horses, and even the original wheel type tractors would sink into the yielding peat land of those regions. A tractor with wheels as large as 7 feet in diameter by 18 feet in width was eventually built to surmount these difficulties, but its great weight made it only partially successful.

Finally, in 1904, the track type tractor was conceived—a power unit that has since become indispensable the world over in building roads, constructing dikes, farming great areas, lumbering, driving army tanks, and performing numerous other tasks that were at one time considered unsurmountable.

In 1906, the steam boilers and engines of the first track type tractors were replaced by four-cylinder gasoline engines, and in 1931, the Diesel engine driven tractor was introduced. Since that revolutionary development, the Caterpillar Tractor Co., Peoria, Ill., has come to lead the world in the production of Diesel engines, track type tractors, and road building machinery. Some of the outstanding operations performed in the Diesel engine division of the 150-acre plant of the concern mentioned will be described in this article.

The manufacture of Diesel engines in this plant differs essentially from that of other plants of the automotive industry in that cylinders, pistons, crankshafts, and other parts are considerably larger in size and yet must be produced within similar tolerances. For example, on crankshafts over 73 inches long, with bearings up to 4 inches in diameter, the bearing and crankpin diameters are held to specified dimensions within plus or minus 0.0005 inch. The angular location of each crank-arm with respect to the center line through the crankshaft bearings must be true within 0.002

to Conquer Giant Tasks

inch on an imaginary circle passing through the crankpins.

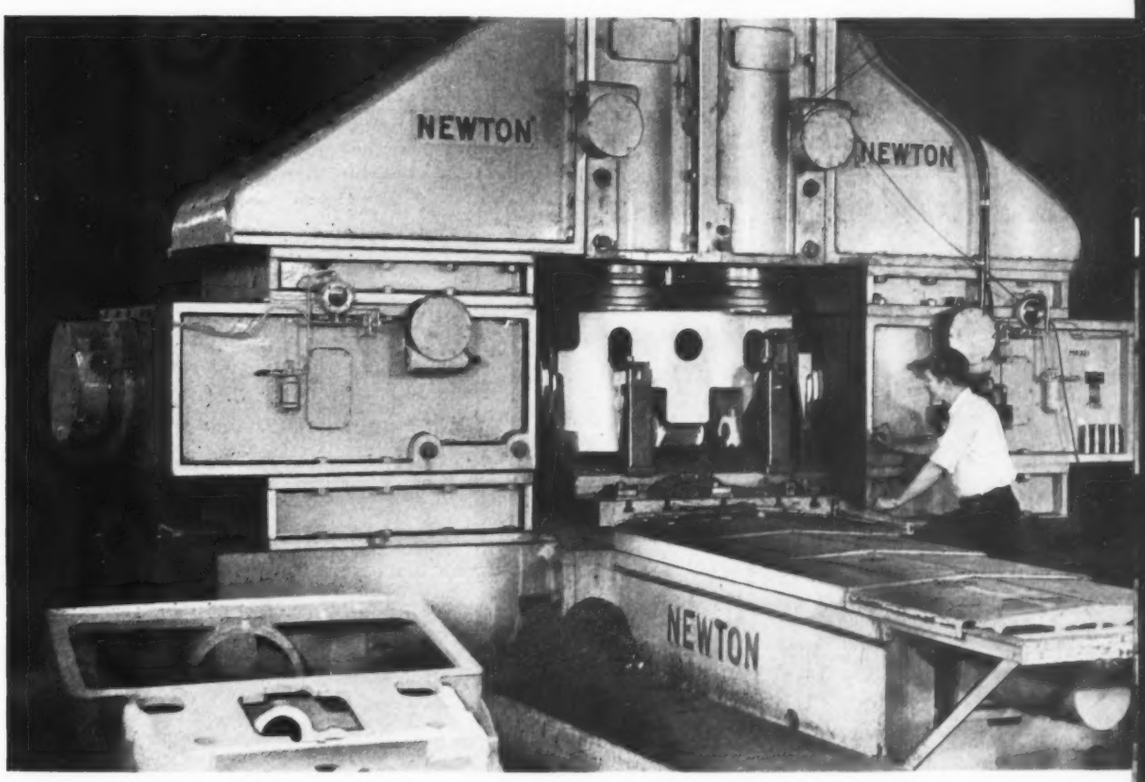
A huge Newton machine recently installed for milling three sides of transmission cases simultaneously is shown in Fig. 1. The three heads of this machine are driven individually by 50-horsepower motors. Two cutters 36 inches in diameter finish the top of the case in conjunction with a smaller cutter at the back of the head, which mills away the narrow band of stock left between the paths of the two larger cutters. At the same time, 32-inch diameter cutters mill the sides of the transmission case. All of these cutters are provided with Stellite blades.

Two operations are ordinarily performed on two different transmission cases in this machine, it being merely necessary to adjust the spindle quills to suit. Should it be necessary to adapt the machine for wider work, this could be accomplished by moving the side-heads farther apart on the machine base and rebolting. The spacers between the base, side-heads, and crown rail could be removed to reduce the height from the table to the crown rail, or thicker spacers could be provided to increase the height. This milling machine has a weight of approximately 110,000 pounds without the motors.

Three special machines were built for sharpening the huge cutters used by this milling machine and others throughout the plant. One of these machines is shown in Fig. 3. It is equipped with a grinding head that is fed up and down on the column in relation to the cutter teeth by hydraulic power. The work fixture is completely universal in that it can be tilted to any compound angle required. It is hand-operated in and out on the bed-ways, and is hand-indexed. Cutters up to 40 inches in diameter can be accommodated.

The crankpins on the larger crankshafts are ground in the Norton machine shown in Fig. 2, which has a capacity of 94 inches between centers. The crankshaft is driven from both ends, power being transmitted from one headstock to the other through a shaft that is enclosed in the tube seen

Fig. 1. Huge Milling Machine in which Cutters up to 36 Inches in Diameter are Used for Machining Three Sides of Transmission Cases Simultaneously



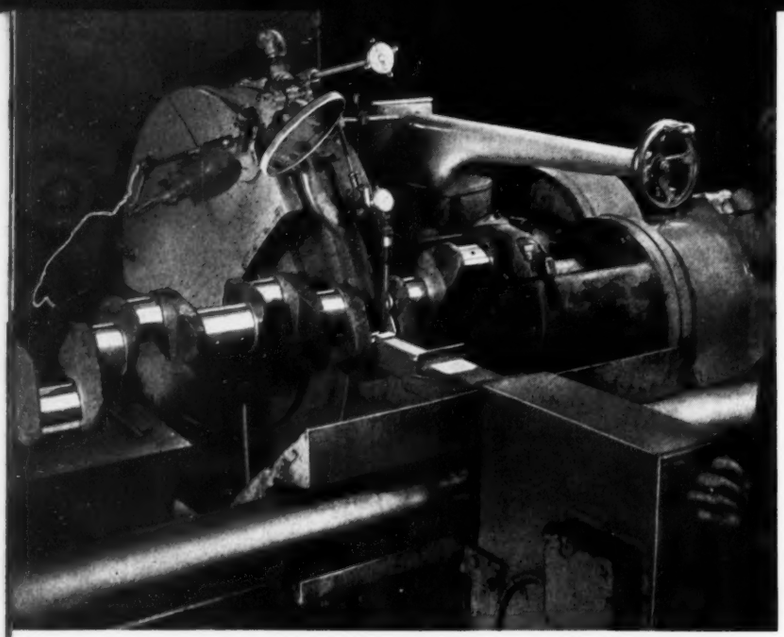


Fig. 2. The Crankpins of Large Tractor Crankshafts are Ground on a Norton Machine Large Enough to Accommodate Work up to 94 Inches between Centers

extending along the front of the machine. Crankshafts with a throw up to 6 inches can be accommodated. The machine has an estimated weight of 36,000 pounds. Accuracy of ground diameters is assured by the application of an Arnold gage. The mirror seen mounted on the grinding wheel guard enables the operator to observe the actual grinding closely.

Cylinder blocks are bored to receive the cylinder liners in the W. F. & John Barnes machine illustrated in Fig. 4, which is designed to accommodate two blocks at one time. The machine is equipped with two boring spindles on one side, so that two bores of each block are machined simultaneously. Then the cylinder blocks are indexed to bring two more bores into position beneath the spindles. Six-cylinder blocks are indexed a third time in their passage through the machine.

Lengthwise locations are accurately made by means of dowel-pins, and the cylinder blocks are located sidewise from the previously milled bearing-lock surfaces. Davis boring-bars, equipped with three sets of cutter blocks each, are employed. Two of the blocks have cutters for roughing and finishing the bores for the major part of their length,

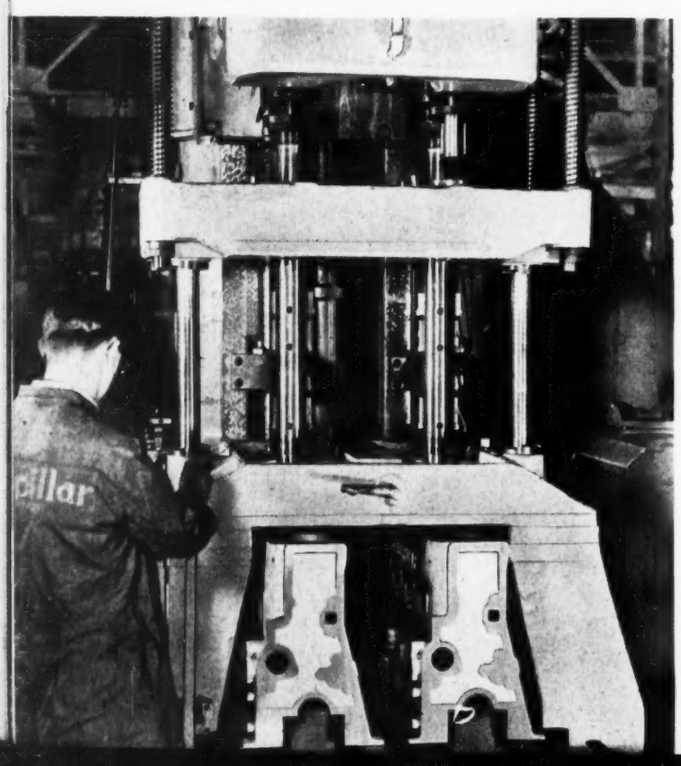


Fig. 3. (Left Center) Hydraulically Operated Machine which was Built Specially for the Sharpening of Milling Cutters up to 40 Inches in Diameter

Fig. 4. (Left) Two Bores are Machined Simultaneously in Two Cylinder Blocks with This Equipment. The Blocks are Then Indexed for Machining the Remaining Bores

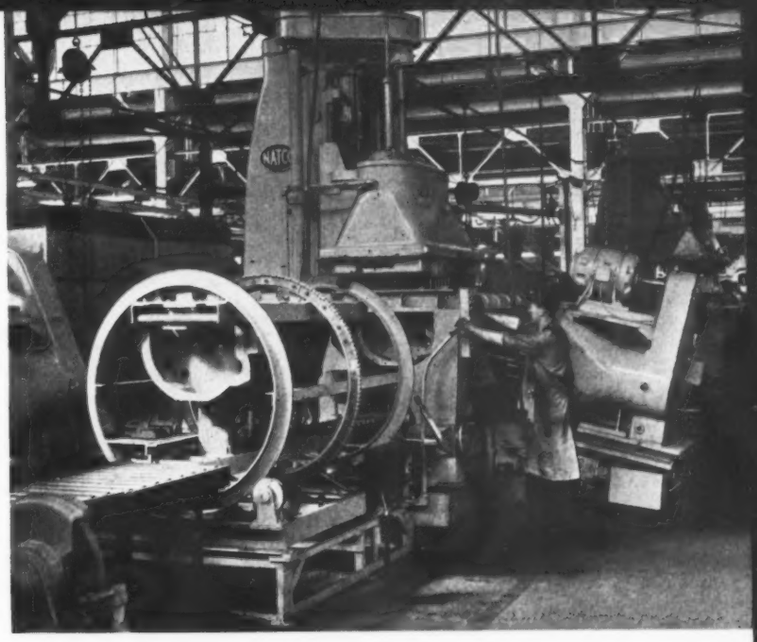


Fig. 5. Multiple-spindle Drilling Machine with Two Hydraulically Fed Heads which Drill a Large Number of Holes in the Bottom and Side of Cylinder Blocks

and the third block has tool bits that are necessary for machining a short portion of slightly smaller diameter.

All along the cylinder line are inspection fixtures for checking the cylinder blocks after every important operation. A typical fixture used for this purpose is illustrated in Fig. 6. Milled surfaces are checked for height, squareness, etc., with suitable gaging devices equipped with dial indicators. Bores, dowel-holes, etc., are inspected for location, diameter, and roundness. In some instances, the inspection fixtures are suspended above the cylinder line and lowered for use, as in the checking of the pump-shaft holes.

One of a group of Natco multiple-spindle machines used for performing a large number of drilling, tapping, and reaming operations on the cylinder block is illustrated in Fig. 5. This particular machine drills all the holes in the bottom of the block, around the pan rail, and on the angular side. The two multiple-spindle heads are hydraulically operated. The preceding operation is performed on the top of the cylinder block and so the roll-over device shown is necessary for bringing the bottom of the block uppermost.

Fig. 6. (Right Center) Inspection Fixtures are Provided along the Cylinder Block Line to Insure that the Blocks Meet Accuracy Requirements at All Points along the Line

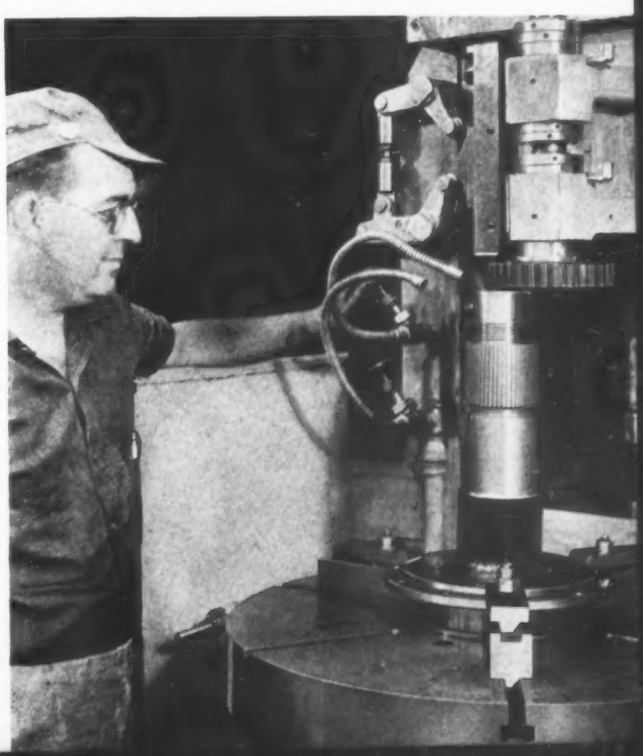


Fig. 7. (Right) Machining the Serrations that are Provided around a Tapered Surface on the Hub to Fit the Sprockets that Drive the Track Shoes

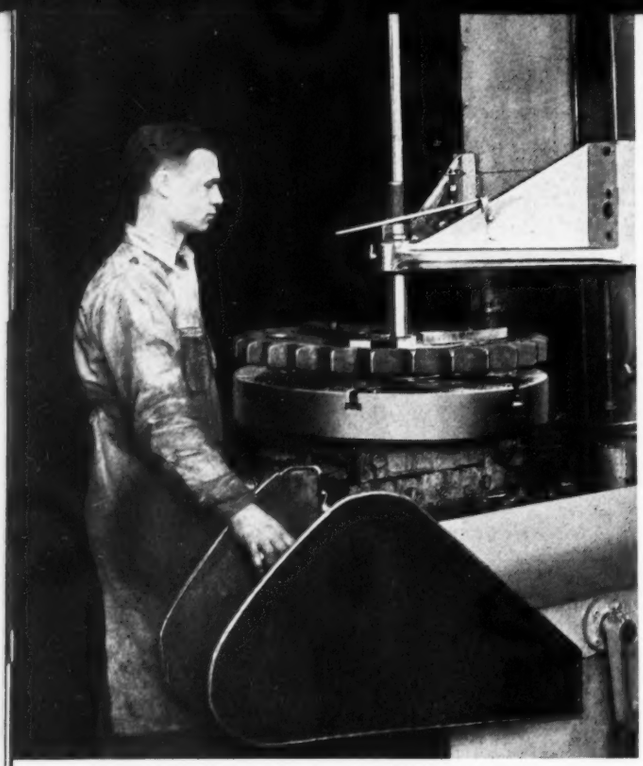


Fig. 8. Broaching Serrations One at a Time in the Tractor Sprockets to Mate the Serrations Cut on the Hub in the Manner Illustrated in Fig. 7. Each Serration is Cut the Full Depth with One Stroke of the Machine

Twenty-two fine teeth or serrations are machined around the bore of the large tractor sprockets and around the hubs that are assembled with the sprockets. Fig. 7 shows the method of cutting the serrations around the hub. This operation is performed on a special Lapointe machine equipped with a reciprocating circular cutter that indexes one tooth after each complete revolution of the hub. Each successive tooth on the cutter cuts the grooves deeper. When the cutter has been indexed eleven times, or half way around, the operation is completed. The next hub is machined with the teeth on the other half of the cutter.

The serrations are formed on the tapered portion of the hub, and so the work is tilted correspondingly on the fixture of the machine, the taper being about 1 1/2 inches per foot. The spacing of these serrations must be accurate within plus or minus 0.0002 inch, with no accumulated error on the entire periphery, and equally close tolerances are specified for the shape of the serrations. This accuracy insures the desired fit with the serrations in the sprockets.

The tapered serrations in the sprockets are produced on the Lapointe broaching machine shown in Fig. 8. In this operation, only one serration is broached at a time, but it is cut to its full depth with a single stroke of the ram, the ram being pulled through the work from below. At the end of the down stroke, the table moves the sprocket a slight amount toward the back of the machine, so that the broach will clear the work on the up stroke. During the up stroke, the work is indexed a distance of one serration and is then fed forward again, into position for the next down stroke. The machine stops automatically at the end of the operation. The sprocket, like the hub, is held in a tilted position because of the tapered surface on which the serrations are machined. The sprockets are steel castings.

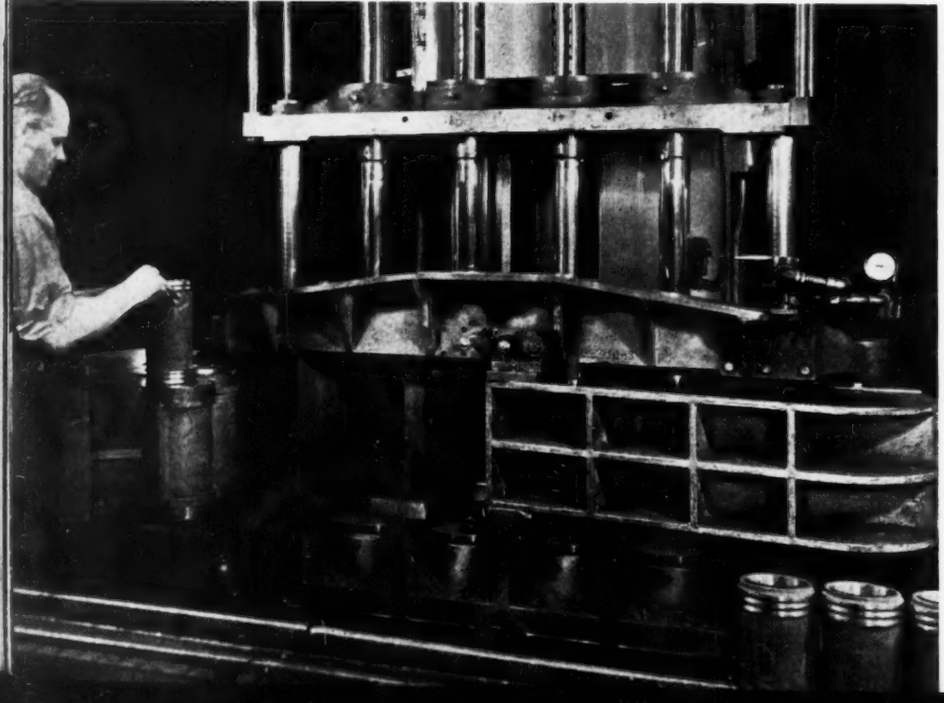


Fig. 9. Cylinder Liners are Bored in a Machine Equipped with an Ingenious Type of Fixture that Greatly Facilitates Loading and Unloading of the Work

FOR GIANT TASKS

Fig. 10. Finish-shaping Teeth on a Tractor Drive Gear Having a Pitch Diameter of over 25 Inches, a Face Width of 5 Inches, and a Circular Pitch of 2.413 Inches. The Operation is Performed on a Fellows Gear Shaper

Cylinder liners are bored four at a time in the machine shown in Fig. 9, which was built by the W. F. & John Barnes Co. This machine is equipped with a work fixture having two large hinged members, one of which opens to the left, as seen in the illustration, and the other to the right. The right-hand member, however, is shown in the closed position. With these swinging members open, the cylinder liners are simply dropped into box type chucks. When the fixture is closed, the liners are swung into place over pilots in the bottom stationary portion of the fixture. The swinging members are then locked in position, after which the hydraulically operated boring head descends and bores the four liners simultaneously. The boring-bars are piloted both above and below the work to provide the desired rigidity.

Flywheels are completely machined in two operations in Potter & Johnston automatic chucking machines. In the first operation, the closed side of the flywheels is held against the face of the chuck, and a series of boring, facing, turning, and reaming cuts are taken on the open side. For the second operation, the open side of the flywheel is held against the chuck face, as shown in Fig. 11, and the flywheel is gripped on the previously finish-turned portion of the rim. Facing, turning, and boring cuts performed by tools on the turret and on the cross-slide complete most of the machining on these parts. In the operations performed by these automatics, the average time per piece is 25.5 minutes. The flywheels are 18 inches in diameter by 5 3/8 inches in width.

Gears of large size are required for driving tractors, as will be apparent from Fig. 10, which shows a final-drive spur gear with a pitch diameter of 25.279 inches and a face width of 5 inches. The circular pitch is 2.413 inches. These gears are rough-hobbed, then heat-treated, and finally finished on the Fellows gear shaper shown.

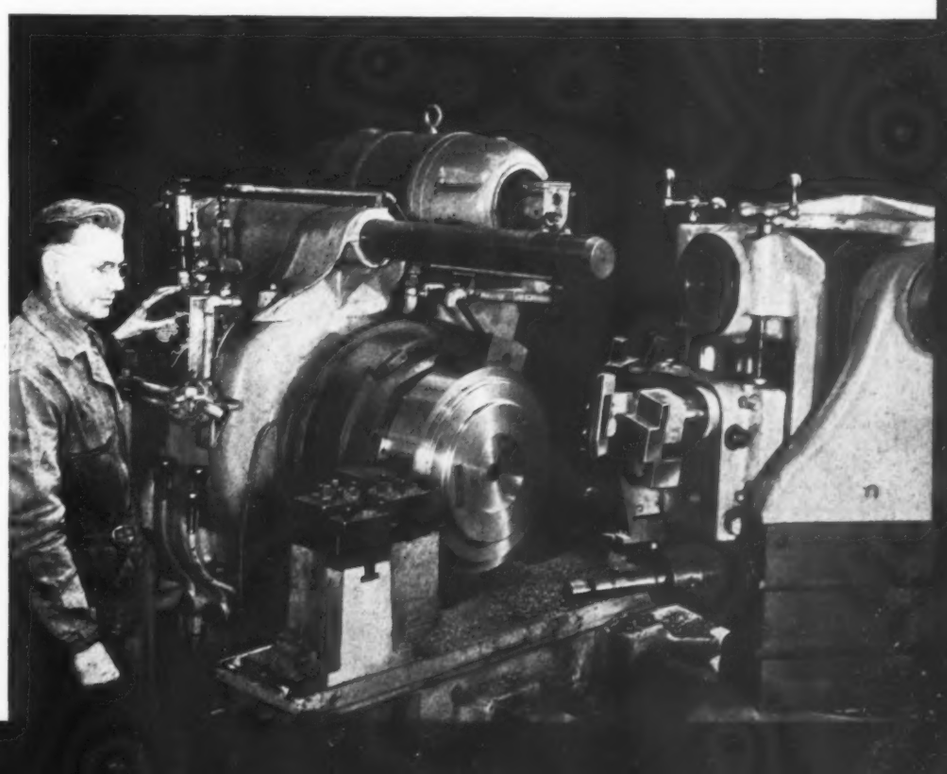


Fig. 11. Flywheels are Finished all over in Two Operations Performed in Potter & Johnston Automatics. This Illustration Shows the Second Operation

Inspection Methods

Fig. 1. An Optical Dividing Head and Measuring Microscope Enable Close Determination of the Accuracy of the Rise and Fall on Camshaft Lobes

THE sizable army of inspectors found in every automobile plant serves the double purpose of insuring that all parts are manufactured to quality requirements and that they can be assembled into automobiles without any special fitting along the busy assembly lines. There are normally about five hundred inspectors in the Pontiac Motor Division of the General Motors Corporation, Pontiac, Mich.—one inspector for approximately every ten other employes. In addition to the inspection activities of these men, however, many of the machine operators are also required to check their work by means of the gaging devices provided.

Many inspection operations are similar in the various plants of the automotive industry, but some distinctive methods will be found in each plant. Some of the more unusual practices in the Pontiac plant will be here described.

Each time that new master cams are installed in a camshaft grinding machine, camshafts produced from those masters are minutely inspected with the Zeiss equipment illustrated in Fig. 1, which consists of an optical dividing head and a measuring microscope. By means of this equipment the inspector can determine the amount of rise and fall of the different cam lobes with extreme accuracy and also determine the points at which the rise starts and the fall ends. Graduations visible through the optical eye-piece of the microscope indicate variations of 0.0001 inch, but as the graduations appear about 1/8 inch apart, much closer readings can be made with ease.

Steel-backed bushings for crankshaft bearings, and other types of split bushings, are checked for dimensional accuracy while under a pressure corresponding to that which will be applied when the bushings are installed in an automobile. This in-

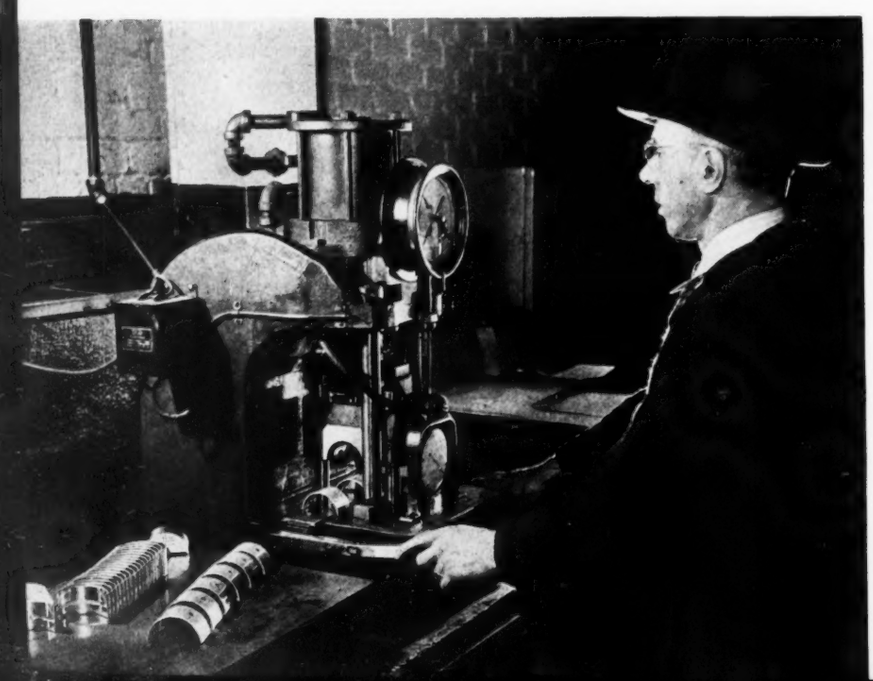


Fig. 2. Arbor Press Arranged for Checking the Radius of Steel-backed Crankshaft Bushings Under a Pressure Corresponding to that Imposed in Service

That Insure Pontiac Quality

spection is performed in machines of the type illustrated in Fig. 2, which comprises an arbor press equipped with a hydraulic cylinder for applying pressure to the ram. The bushing half to be inspected is placed beneath a half-round block attached to the ram and then the desired pressure is applied through the hydraulic cylinder. For example, in checking the steel-backed bushings for rear main bearings a pressure of 1620 pounds is applied and in the inspection of connecting-rod bushings, 860 pounds.

The pressure can be read from the upper gage seen in Fig. 2. However, it is not necessary for the inspector to refer constantly to this gage, because the press is so arranged that a red electric light goes on if the pressure is correct. This feature has been found to greatly expedite the inspection. When the pressure is being applied, the dimensional accuracy of the split bushing is determined by reference to the lower gage on the arbor press, which gives a reading of the vertical position of the half-round block on the bushing being inspected.

Steel-backed bushings for main bearings are held to the specified size within plus or minus 0.00025 inch. They are inspected at the rate of 600 an hour. Split bushings for the small end of connecting-rods are allowed a tolerance of 0.002 inch and are checked at the rate of 1300 bushings hourly. Master blocks are provided for setting the tolerance indicator to suit the part to be inspected. One of these master blocks may be seen in Fig. 2 at the rate of the surface plate to the left of the arbor press.

Ingenious equipment used to determine the amount of air that can be drawn through the combination ventilator inlet and oil filler that is provided on Pontiac engines, is illustrated in Fig. 3. The pipe end of the part is inserted into the right-hand end of the inspection unit, as shown, and clamped air-tight by compressing a rubber bushing around the pipe through the operation of the small lever. Then a motor-driven fan at the left-hand end of the long cylinder is operated to draw air into the cylinder through the ventilator inlet. There is a vacuum inside the cylinder and therefore the amount of incoming air can be determined by means of the mercury gages at the rear of the bench.

The right-hand gage is set to the predetermined air volume requirement and the inspector merely observes the left-hand scale on which the limits are clearly marked. It must be possible to pass from 2.5 to 4.5 cubic feet of air through the element per minute under 1 inch of water.

Every steering knuckle that goes into a Pontiac automobile must first pass a Magnaflux inspection to detect flaws that would not otherwise be visible to the eye. The bench at which this operation is performed is shown in Fig. 4. The operator first places the rough-turned steering knuckle between two magnetic poles, as shown, and applies an electric current of 2200 amperes to magnetize the part. Next, the steering knuckle is immersed in a Magnaflux bath which contains fine particles of iron in suspension. Any flaws at or near the surfaces of the steering knuckle are then clearly indicated through lines formed by the iron particles. The iron particles are released after the inspection by passing the steering knuckle through a simple demagnetizing fixture. A certain percentage of pistons is inspected in a similar manner. Magnaflux equipment has also been installed recently for the

Fig. 3. Special Equipment Devised to Check the Amount of Air that can be Drawn Through the Ventilator Inlet and Oil Filler Provided on Pontiac Engines

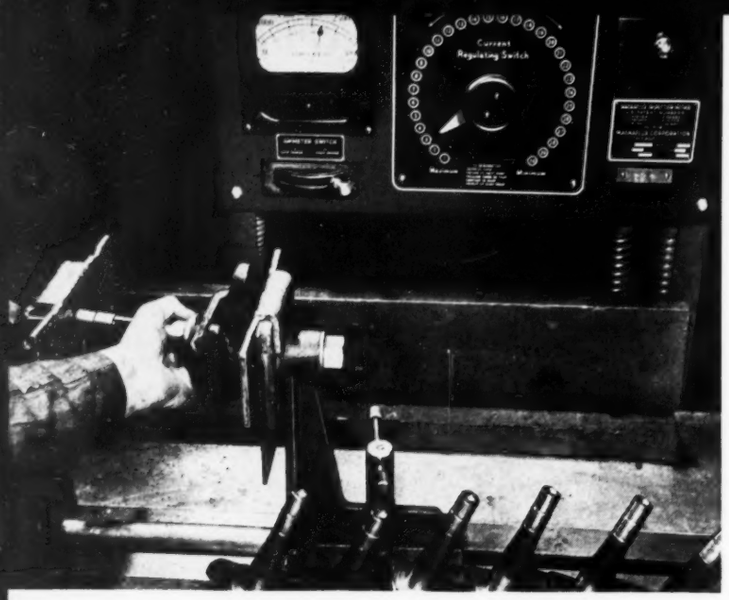


Fig. 4. Steering Knuckles are Inspected by the Magnaflux Process in Order to Disclose Defects that could not be Seen even Under a Microscope

inspection of brake-drums. Automatic equipment performs this inspection at a fast rate.

The special gaging fixture illustrated in Fig. 5 was devised to facilitate the inspection of flywheels for run-out or trueness of the sides and for concentricity of the gear teeth. The sides are checked in the manner shown, by the operator observing the movements of the indicator needle on a dial gage as the flywheel is rotated in contact with the dial-gage spindle. The concentricity of the gear teeth is verified by observing the dial indicator on the left-hand end of the fixture, which, through the use of a pinion as an intermediary, shows up variations in the gear diameter.

Cylinder walls are checked for thickness after rough-boring by means of the magnetic gage illustrated in Fig. 6. This instrument consists essentially of a cylindrical shell that contains a magnet and an energizing coil. Two pole pieces which extend slightly from the shell near the ends are ground to conform to the cylinder bore. The indicating meter at the top of the device, in conjunction with the selector switch seen in front of the man's hand, enables the inspector to take thickness readings of the cylinder wall with either pole piece. The zero reading of the instrument is checked from time to time by applying the instrument to a master.

Variations in thickness are indicated on the scale of the meter, each graduation being equivalent to a difference of 1/64 inch. The wall thickness of cylinders must not vary more than 1/32 inch. The use of this gage is facilitated by suspending it from a balancer located above the conveyor line.

Important dimensions of differential carriers are checked in the gaging fixture shown in Fig. 7. Before the carrier is placed in this fixture, the different bores are checked for diameter and concentricity by means of Swedish indicator gages, limits of plus or minus 0.0005 inch being specified for the diameter and concentricity. The cross bores of the differential carriers are marked according to these readings so as to enable selective assembly of the differential.

After the checking of the bores, one end of a long expanding arbor is inserted into the drive-pinion bore. Then the carrier is placed in the fixture, as shown, with the expanding arbor supported in two V-blocks. Arbors that are permanently mounted in the fixture are next advanced into the cross bores of the differential carrier by turning crank handles. With the differential carrier thus located from the cross bores, the indicator at the back of the fixture, which registers against a bearing on the expanding arbor, can be used to obtain a reading of the squareness of the drive-pinion bore in relation to the cross bores. The bores must be square within 0.002 inch even though the reading

Fig. 5. Inspecting Flywheels for Concentricity of the Gear Teeth and Run-out of the Sides. Two Indicator Gages Insure Accurate Readings

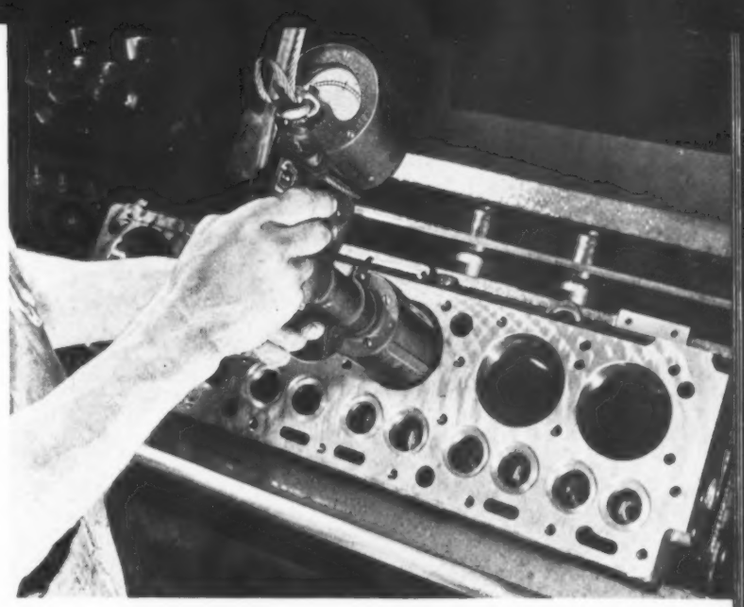


Fig. 6. Magnetic Gage Employed for Determining the Thickness of the Cylinder Walls, which Must not be Permitted to Vary more than 1/32 Inch

is taken at a distance of 12 inches from the center line of the cross bores.

The dial indicator at the left on the front of the fixture is connected to a plug that registers against the under side of the expanding arbor and thus gives a reading of the up or down tilt of this arbor in relation to the cross bores. The center line of the arbor at this point must coincide with the center of the cross bores within 0.001 inch upward or 0.002 inch downward. The plug is raised into contact against the arbor for this reading when the right-hand arbor is entered into the corresponding cross bore and the plug is lowered when the arbor is withdrawn, so as to guard against damage to the plug when the expanding arbor is placed in the V-blocks.

The dial indicator at the right on the front of the fixture is actuated by a finger that registers against a ground shoulder on the expanding arbor, and thus provides an accuracy reading of the distance from the center line of the cross bores to the finished flange face of the differential carrier. This dimension is held to size within plus or minus 0.005 inch and the exact size is stamped on the work for selective assembly. Three men inspect 100 carriers an hour with the Swedish gages and the fixture shown. Masters are placed in the fixture every half hour to check the zero readings of the dial indicators and thus insure inspection accuracy.

The alignment of the bore in the bell housing of cylinder blocks with respect to the crankshaft bearings is checked in a fixture that is provided with two dial gages on a handwheel at the front of the fixture, as shown in Fig. 9. When the block comes to this fixture along the conveyor line, it is slid on an elevating device. The cylinder block is then lowered on hardened and ground locating pads. An air-operated plug at the rear of the fixture next moves forward to enter the rear crankshaft bearing. At the same time this plug pushes the front crankshaft bearing on a stationary arbor at the front end of the fixture.

When the handwheel is then revolved, a contact pin that rides against the finished face of the bell housing gives a reading of the squareness of this face with the center line of the crankshaft bearings. A second contact pin that rides around the counterbore of the bell housing actuates the needle of the other dial indicator and thus discloses any out-of-roundness of the counterbore. The bell housing face must be square with the crankshaft bearings within 0.003 inch and the counterbore must be concentric within 0.0025 inch. About 100 cylinder blocks are inspected hourly with this equipment.

The operation of assembling piston-pins in the pistons is considered of such importance that it has been placed under the direct supervision of the in-

Fig. 7. Inspection Fixture which Facilitates Checking Various Elements of Differential Carriers at the Rate of 100 Carriers an Hour

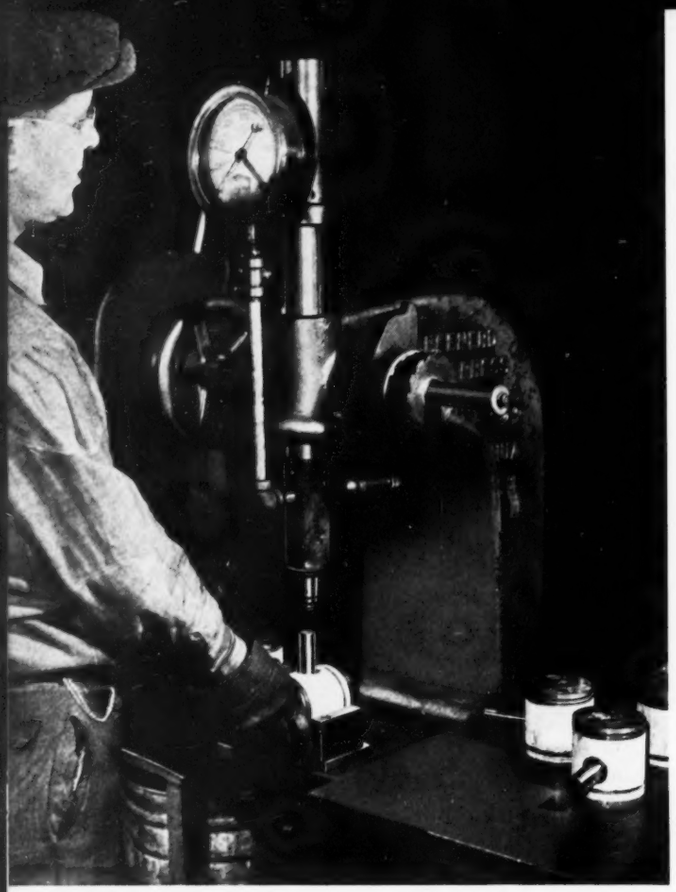


Fig. 8. Piston-pins are Assembled in the Pistons within Predetermined Pressure Limits by means of the Arbor Press Here Shown

spection department. This operation is performed under the arbor press illustrated in Fig. 8, which is equipped with a small hydraulic cylinder and an oil pressure gage.

The pistons come to this machine marked in 0.0001-inch sizes as to hole diameter and the pins are similarly marked. One end of each pin is split. When a pin is pushed into a piston, the pressure must not be less than 175 pounds to force the pin through the first boss and not more than 350 pounds to force it through the second boss.

Crankshafts, flywheels, and clutches are balanced individually within 1/2 ounce-inch, but they are again balanced after these three parts have been assembled and the entire assembly must be in balance within 1/2 ounce-inch. This precaution is taken because if the three parts of any unit were assembled with the heavy sides all in the same plane, the unbalance of the complete assembly could be as great as 1 1/2 ounce-inches.

Checking of the balance is performed on the standard type of General Motors balancing machine, as shown in Fig. 10, the unit being run at 500 revolutions per minute. As the unit revolves, any vibrations of the crankshaft are reflected by a mirror and corresponding readings are obtained from charts at the top and bottom of the machine on the left-hand side. One chart gives readings for the lower end of the crankshaft and the other chart for the upper end. The vibration readings are greatly magnified on the charts, which show the amount of stock that must be removed from

Fig. 9. Gaging Equipment for Determining the Concentricity of the Bell Housing Counterbore and the Squareness of the Bell Housing Face

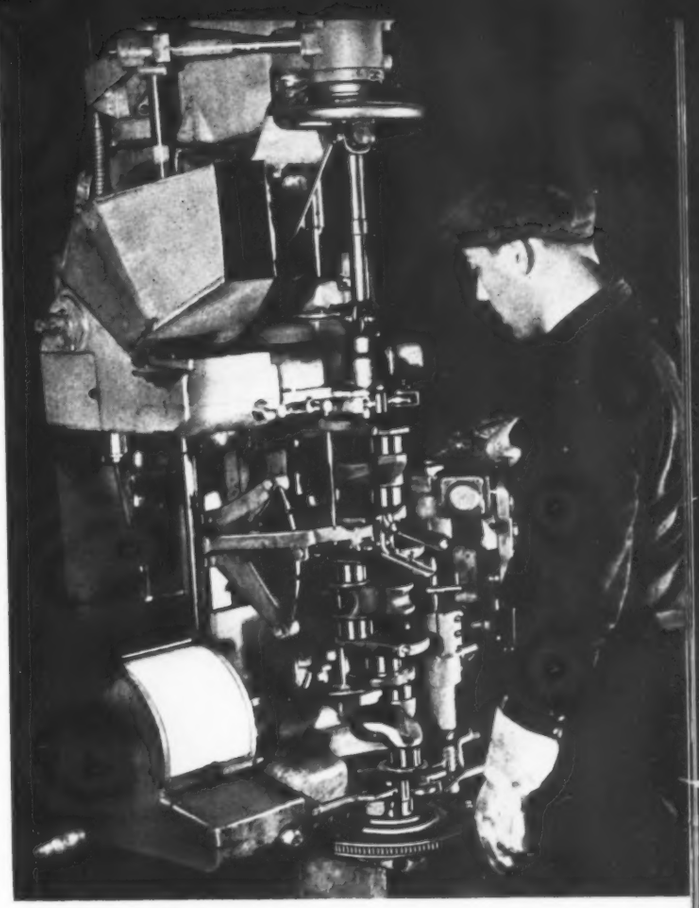


Fig. 10. Crankshafts, Flywheels, and Clutches are Balanced Individually and Then Again Balanced after These Three Parts have been Assembled

the unit in order to obtain balance. Graduations on a collar mounted on the machine spindle indicate the angular plane of the assembly in which unbalance exists. Corrections for unbalance are made by drilling the flywheel. A drilling head is provided on the right-hand side of the machine for this purpose.

The largest inspection equipment in the plant is the fixture used at the end of the assembly line for checking the setting of the front wheels in relation to the center of the car and the rear wheels. The front wheels are driven into two blocks, of which one is seen in Fig. 11. These blocks are connected by toggles which enable the blocks to adjust themselves sidewise as the rear wheels are driven on stationary troughs. A man on the front seat of the automobile holds the steering wheel in the proper position while men in the pit below the conveyor line adjust the tie-rod of the car according to readings which are obtained from large dials. The proper "toe in" of the front wheels is thus insured.

While these adjustments are being made, a checking device is lowered in front of the car within 2 or 3 feet of the headlights. The lights are then adjusted until they are focused correctly with respect to cross lines on the checking device.

Up to 750 cars pass over the assembly line per day and across the wheel checking fixture. The hundreds of inspections performed on the individual parts and sub-assemblies enable this mass production to be carried on smoothly and insure finished automobiles of the desired quality.

Fig. 11. At the End of the Assembly Line the Front Wheels of Each Automobile are Inspected for "Toe in" and the Head Lamps are Correctly Focused

The Mercury—the Medium-priced Automobile which has Recently been Placed on the Market by the Ford Motor Co.

Drawing the for the

THE engine hood on the Mercury—the medium-priced automobile brought out this season by the Ford Motor Co.—is of especial interest to stamping experts throughout the automotive industry because of the fact that this unusually deep hood is made from a single piece of sheet metal. The hood is approximately 15 1/2 inches deep at the maximum point, 55 inches wide, and 60 inches long. The more important operations involved in producing these hoods in the Detroit plant of the Murray Corporation of America, are shown in the accompanying illustrations.

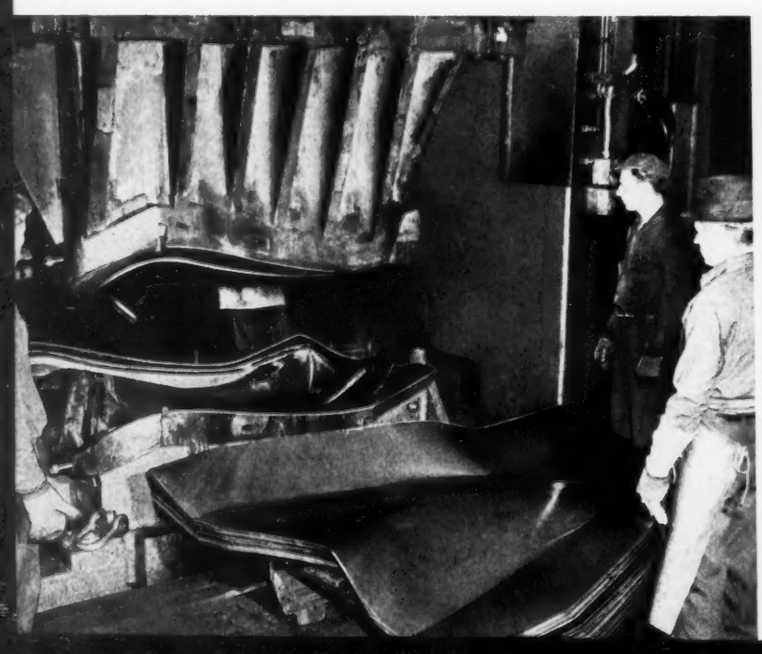
Blanks for the production of this engine hood are cut from sheet steel, 0.039 inch thick, with parallel ends and with the sides running at equal angles from a width of 76 inches to a somewhat narrower width. Two blanks are produced from one rectangular sheet of steel 137 inches long by 72 inches wide, thus practically eliminating scrap. The blanks are then bent to the shape of the stock pieces seen in Fig. 1 lying in front of the dies that are used for the first drawing operation.

This operation is performed in the Clearing 350-ton double-action press shown. The blank is clamped between the dies as the press ram descends, during which action the blank is also bulged around the edges. As the ram completes its stroke, the center of the hood is pushed downward and drawn to the shape seen at the left in Fig. 2.

The next operation consists of trimming the stamping and notching the front end, as seen at the left in Fig. 3. This operation is performed by the die equipment shown, which is mounted on a

Fig. 1. (Below Left) Dies Used for the First Drawing Operation on Mercury Engine Hoods. The Sheet-steel Blanks are Delivered to This Press after a Preliminary Bending

Fig. 2. (Below Right) View of the Same Drawing Dies as Shown in Fig. 1 and, at the Left, an Engine Hood as it Appears after the First Drawing Operation



Engine Hood Mercury

Hamilton 150-ton single-action press. Then the deep center vee produced in the drawing operation is flattened out in the 150-ton press seen in Fig. 4. At the same time that the stamping is flattened, the notch at the front end is closed and the desired shape of nose obtained.

The stamping is now transferred to a set of restriking dies which form a bead about 4 inches wide along the entire length of the stamping on top. At the same time, flanges are formed on both sides and at the rear, the sides are trimmed, and all flanges are restruck. Subsequent operations consist of arc-welding the nose to close the crack remaining after the notched edges have been pushed together; spot-welding reinforcement strips on the inside of the hood; and piercing holes through the flanges and sides.

The hood stampings are then completely inspected on gaging fixtures of the type shown in Fig. 5, which are provided with templets to insure that all edges will be of the required contour within close limits. This inspection insures that each hood will center itself when assembled on a car, that the bottom edges will fit closely against the fenders, and that the back end of the hood will be a close fit along the body cowl.

The location of the holes for hinge-bracket bolts is another important element checked at this time. Finally, the surfaces of the hood stamping must be smooth all over and free from high-lights. The inspection fixtures have been made to the desired contours within tolerances of a few thousandths of an inch.

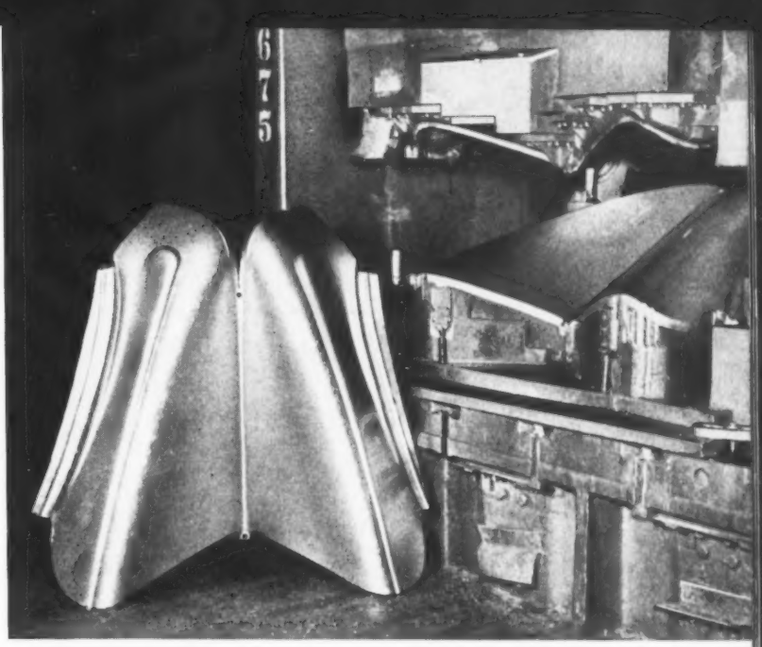
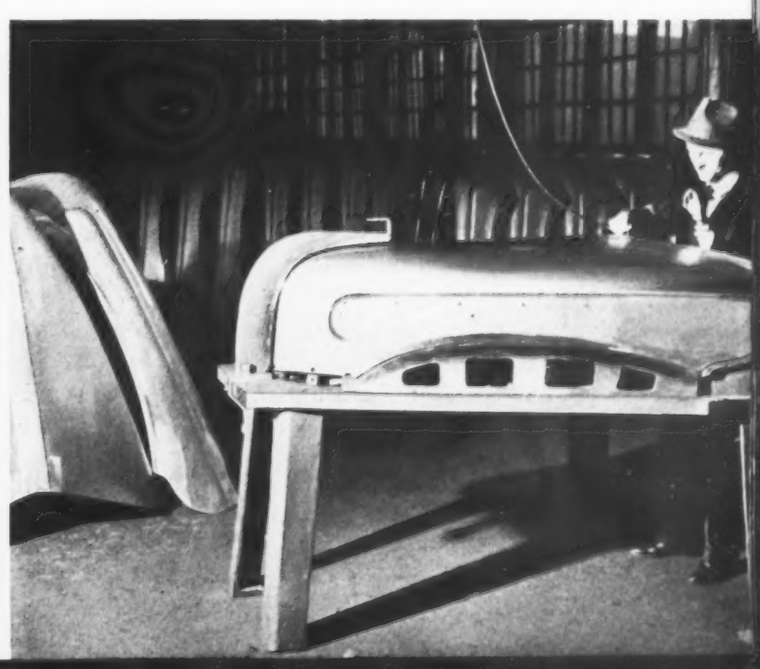


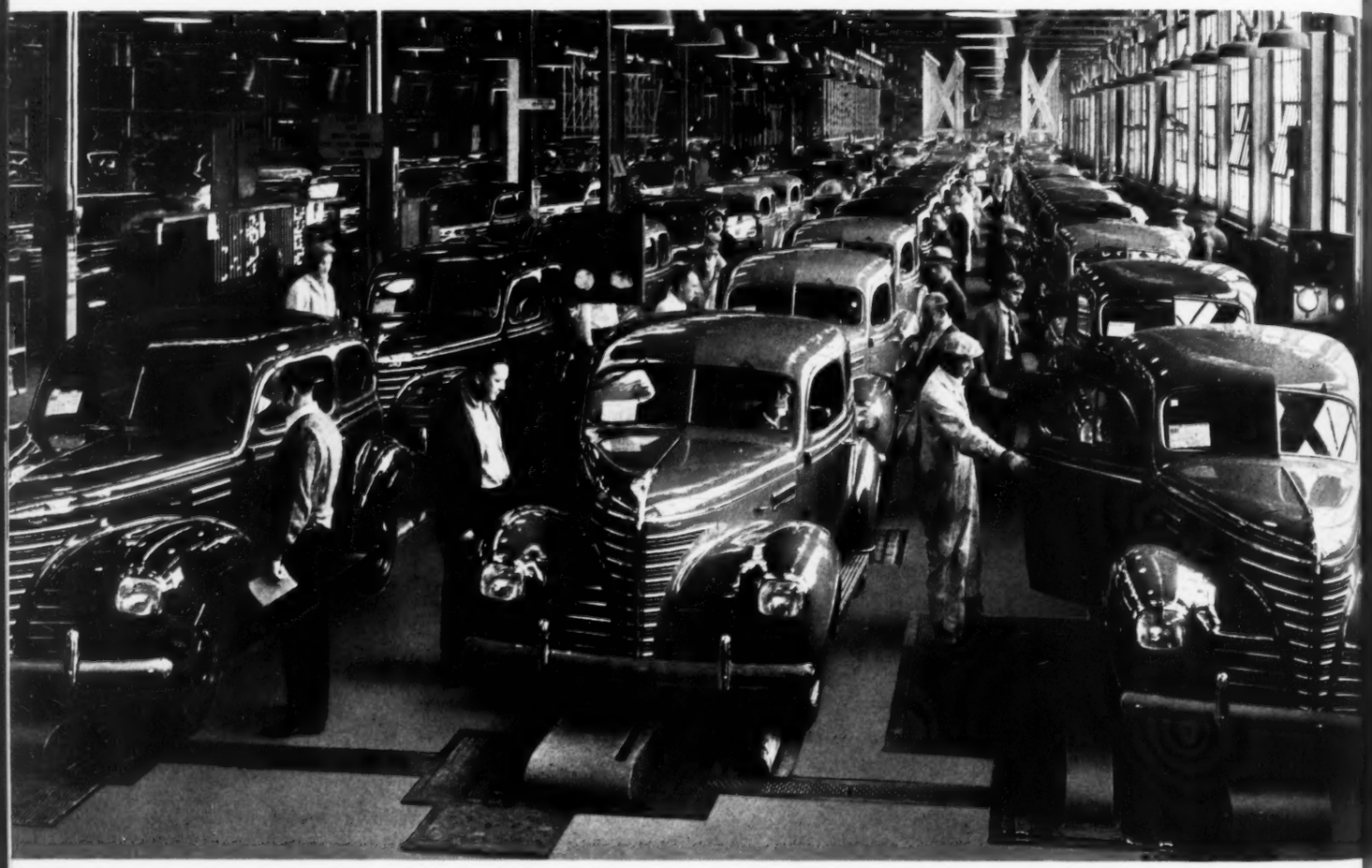
Fig. 3. The Trimming Dies also Cut a Notch in the Front End of the Engine Hood to Permit the Formation of the Nose

Fig. 4. (Below Left) Die Equipment Employed for Flattening the Top of the Engine Hood and Closing the Nose Preparatory to Arc-welding the Nose Joint

Fig. 5. (Below Right) Every Engine Hood Must Pass a Rigid Inspection for Contour of All Edges and Surfaces, Location of Holes, and Surface Appearance



Typical Operations at Plymouth Where



THREE cars completely assembled every minute—that is the regular production schedule of the Plymouth Motors Corporation, Detroit, Mich., a division of Chrysler Corporation. This is believed to be the highest output of any one assembly plant in the world. All types of cars—sedans, coupes, roadsters, etc., with various paint finishes—are put together along the same assembly lines, the right parts arriving at the assembly lines as each car comes along. This is possible only because of the efficient system that has been devised to insure that bodies, fenders, hoods, etc., of the right color and the proper special appliances reach the assembly lines from the feeder lines exactly when required.

The arrival of the various units and parts in the desired sequence is controlled from the "dispatcher's office," shown in Fig. 4. Men in this office constantly send out messages by telephone and a Telautograph system, instructing the different departments as to the order in which supplies are to be sent on the feeder conveyors that go to the assembly lines.

A visual record of the progress made in issuing these instructions is maintained by moving washers of different colors on the pegs of the table seen in the foreground in Fig. 4. Each of the pegs represents a particular type and color of car. For example, one peg refers to black four-door sedans, another to green coupes and so on.

Washers of different colors are used to indicate the number of car assemblies ordered at a time. For example, the removal of a yellow washer indicates that parts are to be ordered for twenty cars; a black washer, five cars; a red washer, ten cars; and a white washer, one car. Thus, if five steel-gray sedans are to be assembled in succession, a black washer is lifted from the peg assigned to that type of car as the required supplies are ordered from the different departments.

As in every other automobile plant, however, the assembly of the cars is the final stage in the manu-

Three Cars are Assembled a Minute

facture, thousands of machining and testing operations first being necessary to prepare the multitude of parts for assembly. Many of the manufacturing operations in the Plymouth plant are typical of those performed in other plants, but some methods have been developed, of course, to meet special conditions. A few such methods will be described in the following.

Right- and left-hand hydraulic cylinders for front wheels are successively drilled and counterbored, drilled a second time, spot-faced, and tapped in four stations of the five-station indexing type of machine shown in Fig. 1. The fifth station is used for reloading. With each indexing of the worktable, the hydraulically actuated fixture makes a feeding movement upward and a quick return. A right- and a left-hand cylinder are held in each station of the work fixture in the necessary positions for machining the hole at the prescribed angle in each cylinder. The machine head is provided with eight spindles, so that one piece of each hand is completed with every indexing of the fixture.

Cylinders for the rear wheels are handled by the machine illustrated in Fig. 2. This machine is equipped with a hydraulic head for performing two drilling and countersinking operations, and with a tapping head that has a lead-screw for positively feeding the taps. A reversing motor on this head

Fig. 1. Special Machine Developed for Drilling, Counterboring, Spot-facing, and Tapping an Angular Hole in Hydraulic Cylinders for Front Wheels of Plymouth Cars

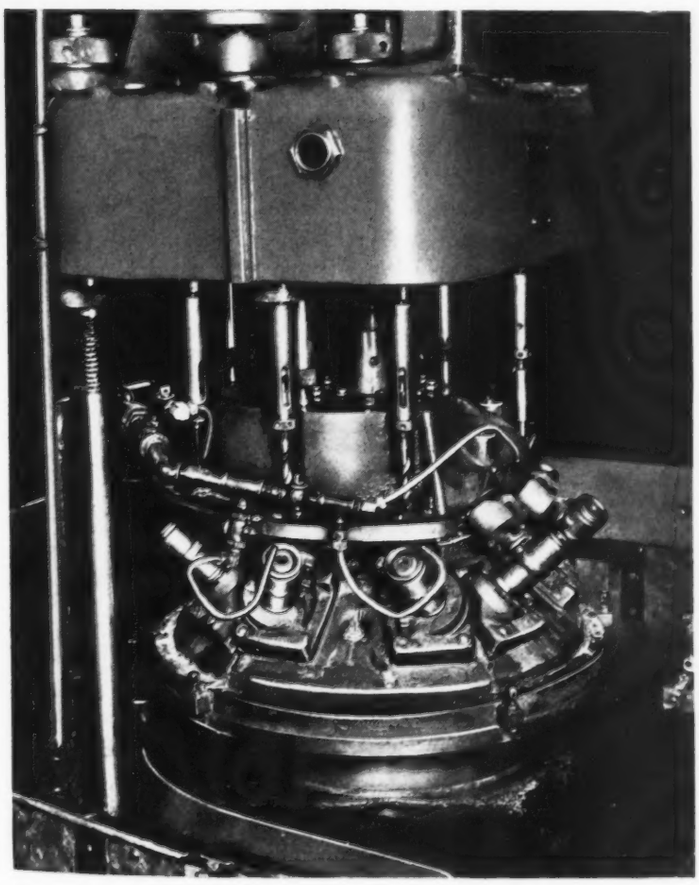
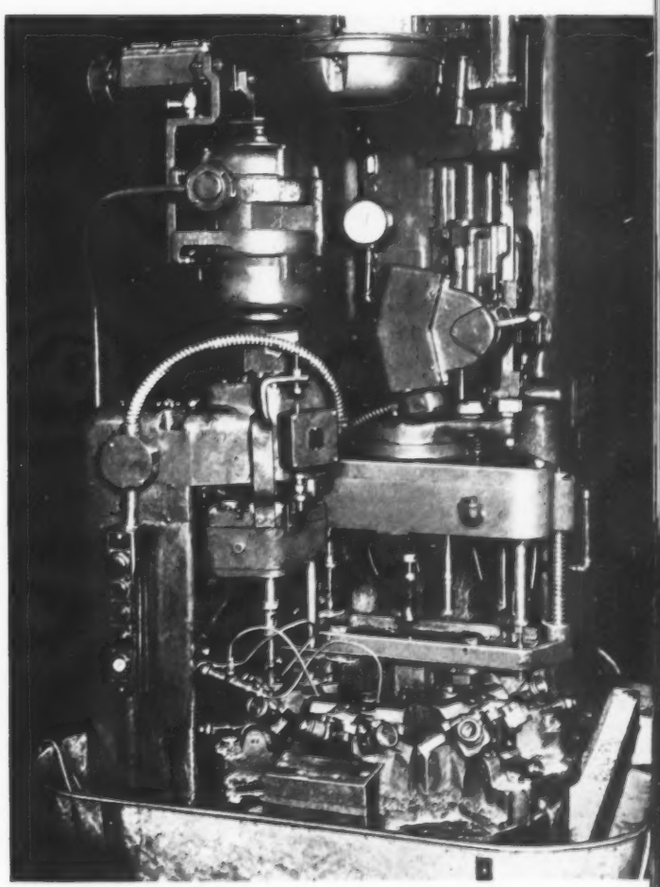


Fig. 2. Another Special Machine Designed for Drilling, Countersinking, and Tapping a Hole at an Angle in the Hydraulic Cylinders Provided for the Rear Wheels



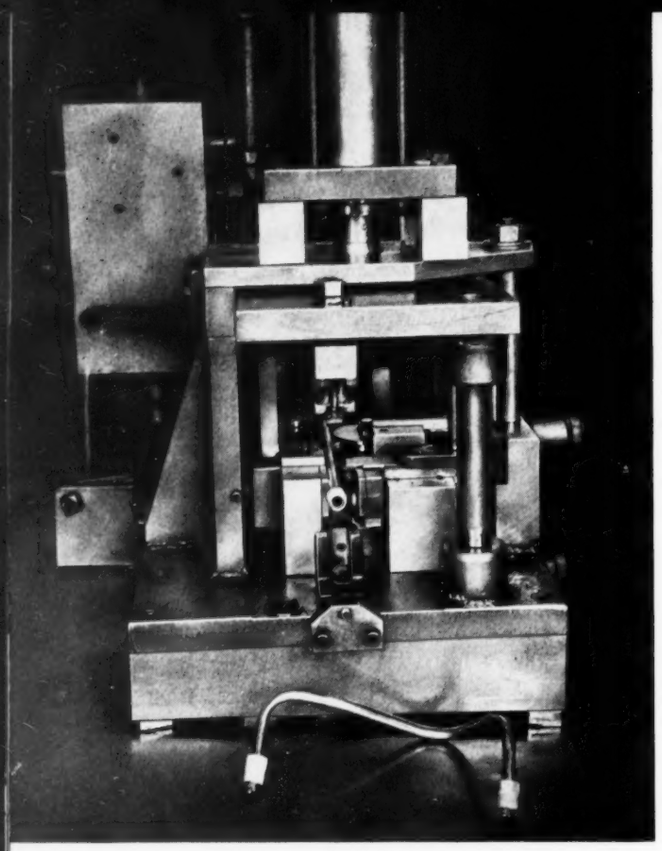


Fig. 3. Hydraulically Actuated Machine Used for the Automatic Bending of Tubing into a Variety of Shapes for Use as Oil-pump Inlet and Outlet Tubes

provides for withdrawing the taps upon the completion of the operation.

The work fixture indexes counter-clockwise beneath the two heads, a right- and a left-hand wheel cylinder being held in each station of this fixture also, so that one part of each kind is completed with each indexing. Two stations at the front of the fixture are always idle for reloading.

Several small machines of unique design have been developed for bending oil-pump inlet and outlet tubes to the required shapes. One of these machines, which is illustrated in Fig. 3, makes four bends in a piece of tubing, as shown by the example lying on the bench in front of the machine. The straight piece of tubing with threaded fittings assembled on the ends is placed in this machine as shown. The tubing is first clamped and then bent to the desired shape as a series of slides are moved horizontally and vertically against the tubing through oil pressure from the overhead cylinder.

The horizontal slides are actuated by the descending of bars mounted on the plate that is attached to the hydraulic piston. This plate is guided in its vertical movements on pilot-bars that extend upward from the fixture base. Springs return the various forming slides to their normal positions when the hydraulic piston again moves upward.

Both ends of rear-axle housings are machined simultaneously in a double-end machine illustrated in Fig. 6, which is equipped with a seven-station trunnion fixture. The rear-axle housings are centrally located in the fixture from the banjo face, equalizing fingers registering in the bore of the banjo. The ends of the rear-axle housings are placed in jaws of an equalizing design, which are locked by means of two rollers on a slide that is advanced on each end of the housing by turning a screw. The screw is turned by socket wrenches attached to the crank-handles shown.

Fig. 4. The Dispatcher's Office Controls Supplying of Parts to Assembly Lines and Insures Assembly of Various Types of Cars without Confusion

From the loading position, the work is indexed forward and around the bottom of the machine. With each indexing, a hydraulically operated tool-head on each end of the machine advances tools to the work. Pilot-bars on the tool-heads engage bushings in the rotary fixture to insure accurate alignment of the work with the tools and to lock the fixture securely for each operation. The tool-heads recede rapidly at the end of their forward movements to allow the fixture to index again and bring another rear-axle housing into the correct position relative to the tools.

In the second station of this machine, the bearing and retainer bores are rough-bored and chamfered on both ends. In the third station, the bearing bores are semi finish-bored, the retainer bores are finish-bored, and the flanges are turned and chamfered. Both sides of the two flanges are rough-faced in the fourth station by tools that are fed inward radially along the sides of the flanges. Both outer faces of the flanges are then semi finish-faced in similar manner in the fifth station.

The bearing bores are finish-reamed in the sixth station, and in the seventh station, which is seen at the top of the machine in Fig. 6, holes are drilled and reamed in the flanges by combination tools.

The latest method of finishing machined surfaces —Superfinishing—is now being applied at the Plymouth plant on a real quantity production basis. Crankshafts, pistons, and camshafts are all being Superfinished in sufficient quantities for supplying the great number of cars produced every day. A view of a crankshaft Superfinishing machine is illustrated in Fig. 5. This machine Superfinishes all of the main and crankpin bearings simultaneously. When the crankshafts leave this operation, the Superfinished surfaces have a smoothness within 6 and 7 micro-inches, which is equivalent to between six and seven millionths of an inch.

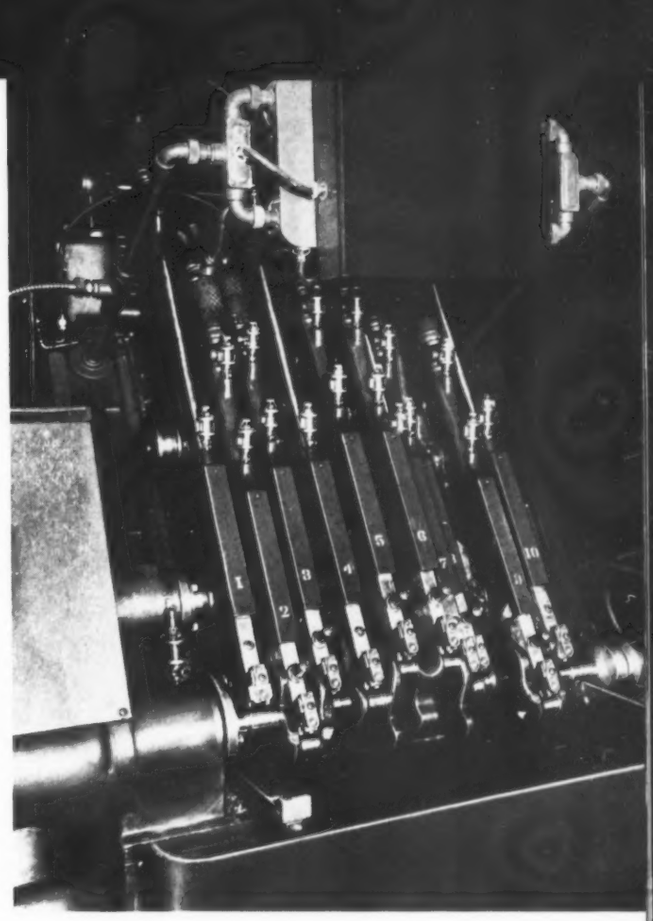


Fig. 5. Superfinishing Machine which Imparts the Final Finish to All the Main Bearings and the Crankpins of Plymouth Crankshafts Simultaneously

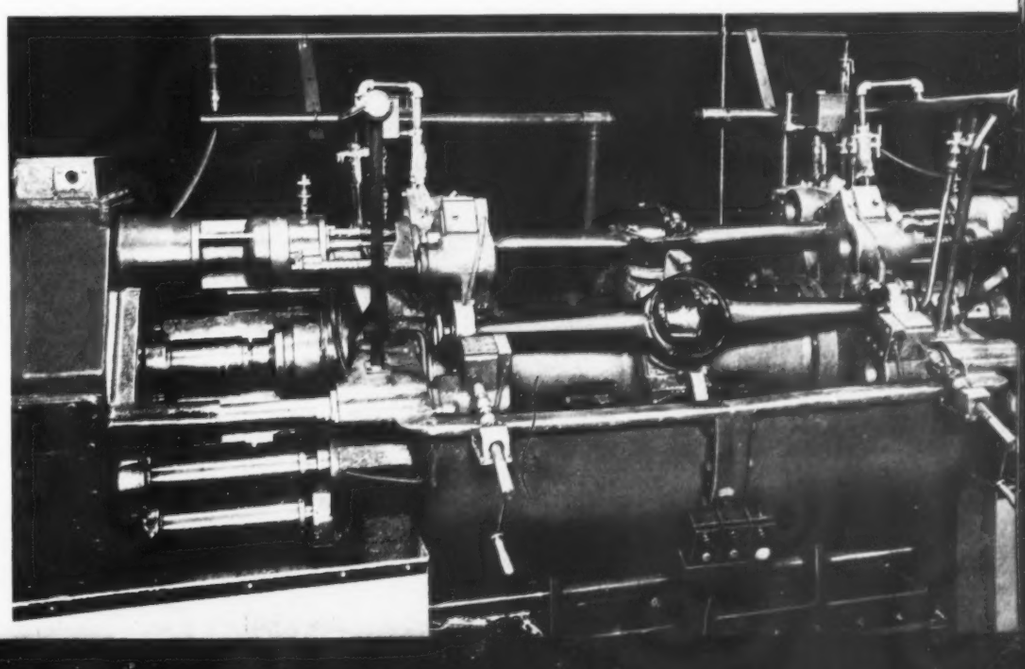
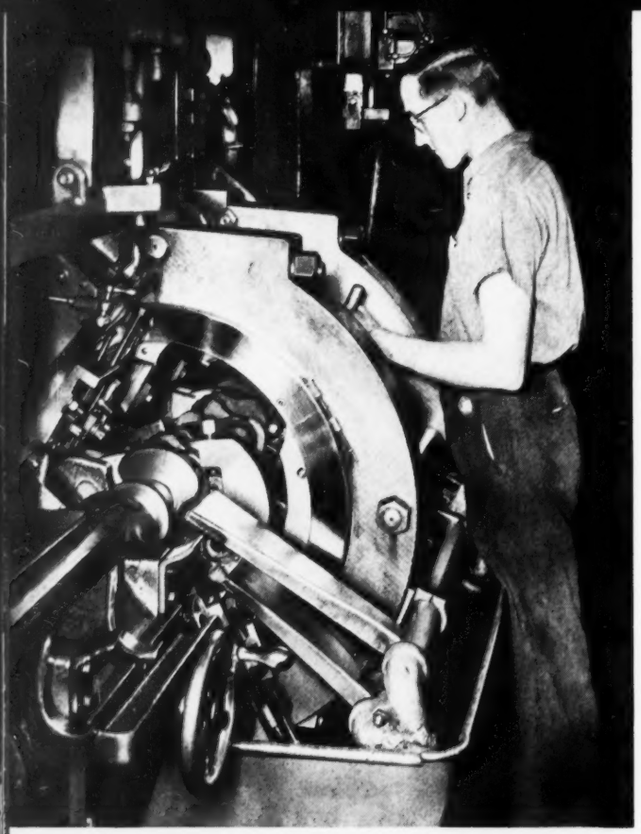


Fig. 6. A Hydraulically Operated Double-end Machine which Performs Several Machining Operations on the Two Ends of Rear-axle Housings

New International Equipped for

The Latest Engine Plant of the Automotive Industry was Recently Placed in Operation at Indianapolis by the International Harvester Co. This Truly Modern Plant is Devoted Entirely to the Production of Motors for Driving Trucks



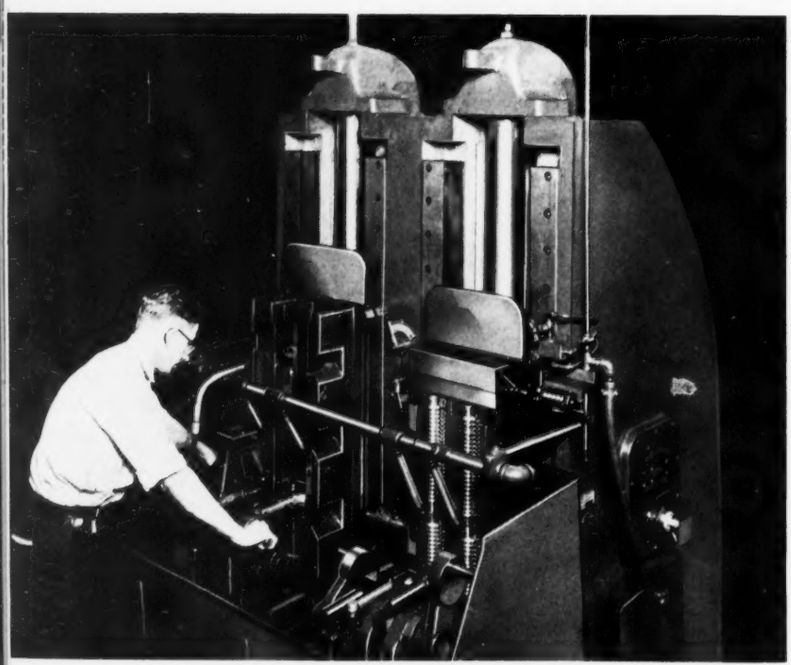


Fig. 1. (Above) Le Blond Crankshaft Lathe Equipped with Tools for Turning and Facing All Main Bearings Simultaneously, as well as All Diameters on the Flange and Pulley Ends of Crankshafts. The Performance of This Machine Makes it Possible to Grind the Bearings to Size without a Second Turning

Fig. 2. (Center) Dual-ram Colonial Machine which Surface-broaches Connecting-rods and Caps on Both Sides of the Crank Bearing, the Back of the Bolt Bosses, the Half Holes, the Contact Faces, and the Width of the Bolt Bosses. A Rod and Cap are Broached in Each Station of One Fixture and a Rod and Cap in Different Stations of the Other Fixture

Fig. 3. (Left) Battery of Six Natco Single-spindle Machines Used for Finish-reaming the Cylinder Sleeves, which are Accurately Seated and Clamped in Pot Type Fixtures. The Sleeves are Honed after the Reaming Operation. One Operator Attends the Entire Battery of Machines

Truck-Engine Plant Latest Methods

The Manufacturing Building Covers an Area of 363,000 Square Feet and is Fitted out with the Latest Types of Machine Tools and Miles of Roller and Trolley Conveyors to Expedite Production. Interesting Operations are Here Illustrated

Fig. 4. (Above) Two Barnes Machines Used for Honing the Crank-bearing End of the Connecting-rod and Cap Assemblies. Four Assemblies are Honed at One Time by Placing Them above Each Other in the Multiple Type Fixture Shown, with the Piston-pin Bores of the Individual Rods Located over Separate Plugs

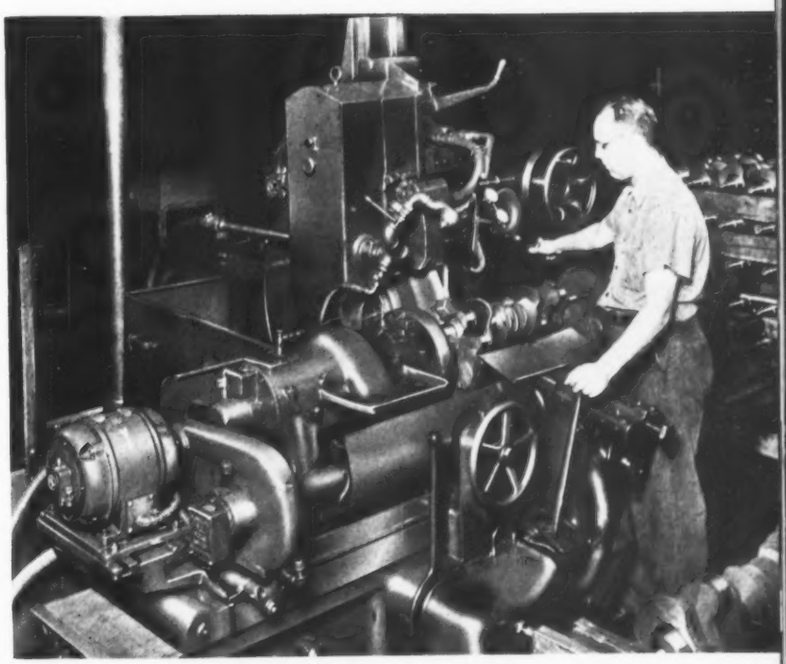


Fig. 5. (Center) Crankshafts are Completely Ground on Landis Machines. This Illustration Shows a Hydraulically Operated Machine Grinding the Crankpin Bearings on a Crankshaft. An Arnold Indicator Gage Automatically Sizes the Work while the Operation is Going on, so that the Operator Knows when the Required Dimension has been Attained

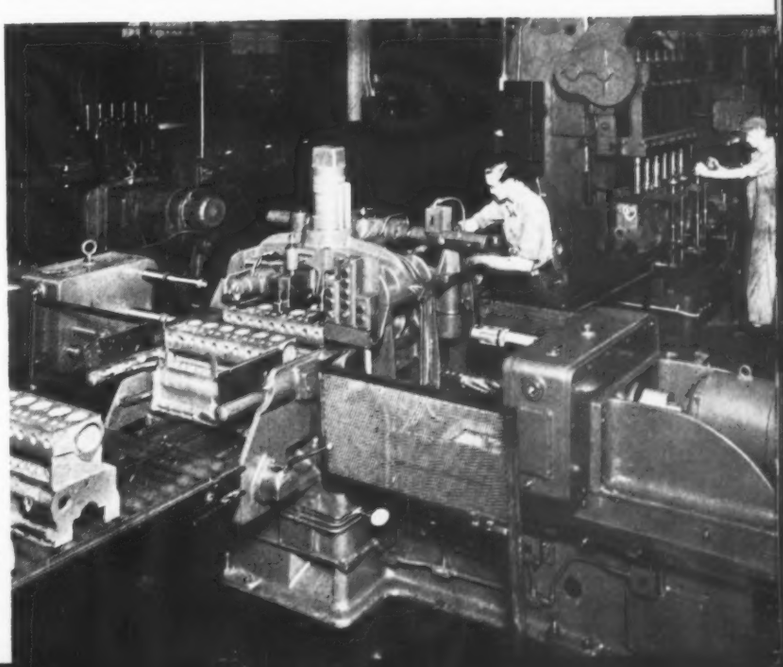


Fig. 6. (Right) Machine Built by the W. F. & John Barnes Co. for Drilling and Boring Both Ends of Cylinder Blocks at the Same Time. The Oil Gallery Hole is Drilled One-half the Length of the Block from Each Side. The Blocks are Automatically Loaded, Clamped, and Unloaded

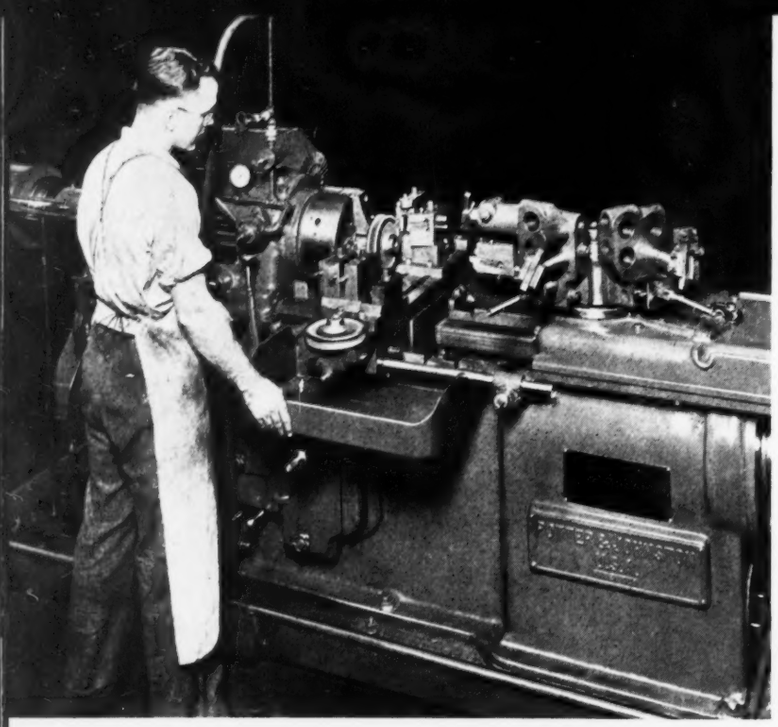


Fig. 7. (Left) Potter & Johnston Automatic Employed for Turning, Boring, Reaming, Facing, and Rough- and Finish-grooving the Fan Drive Pulley. Uniformity of Work Size and Finish is a Feature, in Addition to the Advantage of a High Production Rate

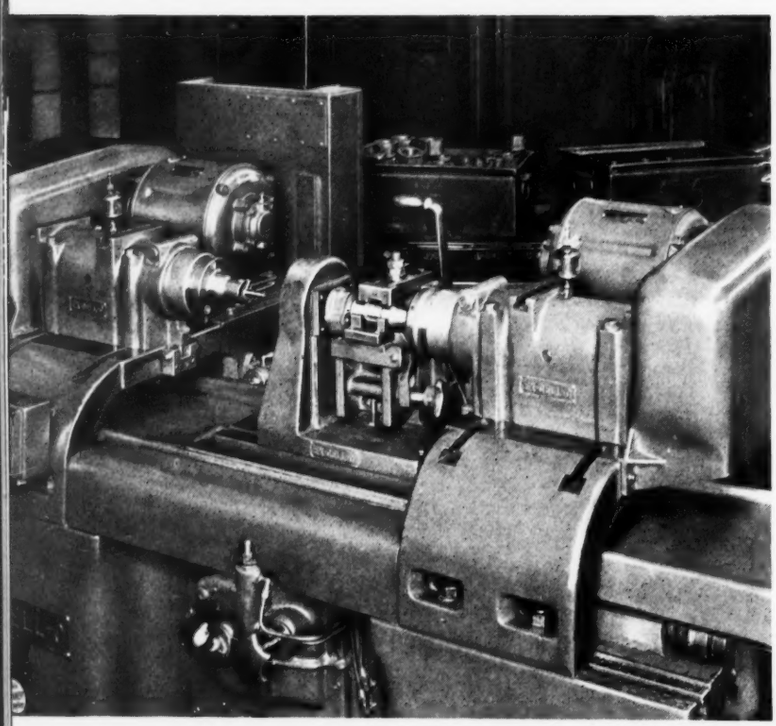
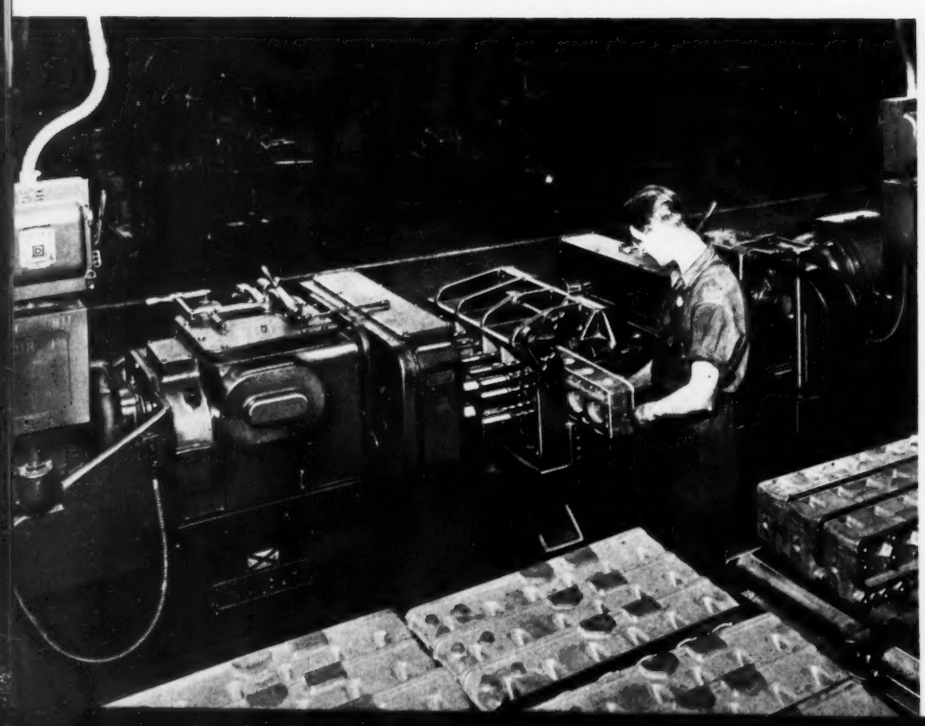
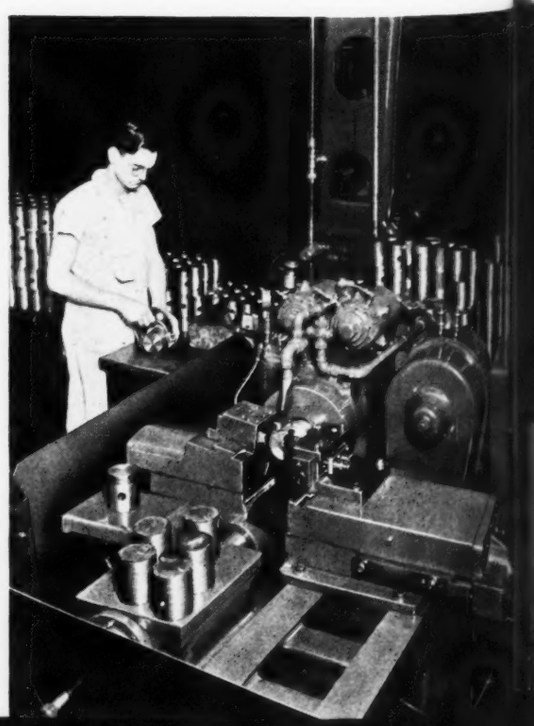


Fig. 8. (Center) Ex-Cell-O Double-end Precision Boring Machine which Finish-bores the Gear-shaft Hole and the Gear Bore in the Oil-pump Body. This Machining Method Insures Accurate Alignment of the "Heart" of the Force-feed Oil System Provided on International Truck Engines

Fig. 9. (Below Left) All Holes in the Top and Bottom of Cylinder Heads, as well as All Stud Holes Through the Cylinder Heads, are Drilled by the Foote-Burt Two-way Machine Here Shown. Accurate Spacing of Holes is Insured by the Tooling Arrangement

Fig. 10. (Below Right) Pistons are Semi Finish-turned, Rough-faced on the Closed End, and Rough-grooved in This Gisholt Hydraulic Automatic Lathe. The Pistons are Held by Means of an Air Chuck during the Machining Operation, in which Tools Operate from the Front and Rear of the Machine





NEW ENGINE PLANT

Fig. 11. (Right) Inspection Fixture Designed for Simultaneously Checking the Run-out of the Base Circle of All Twelve Cams on Truck-engine Camshafts. While the Camshaft is Slowly Revolved, Dial Indicators Graduated to 0.001 Inch Show the Amount of Run-out

Fig. 12. (Center) Determining whether Pistons are within the Weight Tolerance of Plus or Minus 1/8 Ounce. They are then Inspected for Outside Diameter and Piston-pin Hole Size and Stamped Accordingly. The Pistons are next "Ribbon Fitted" to the Engines and Returned to the Rod and Piston Assemblers

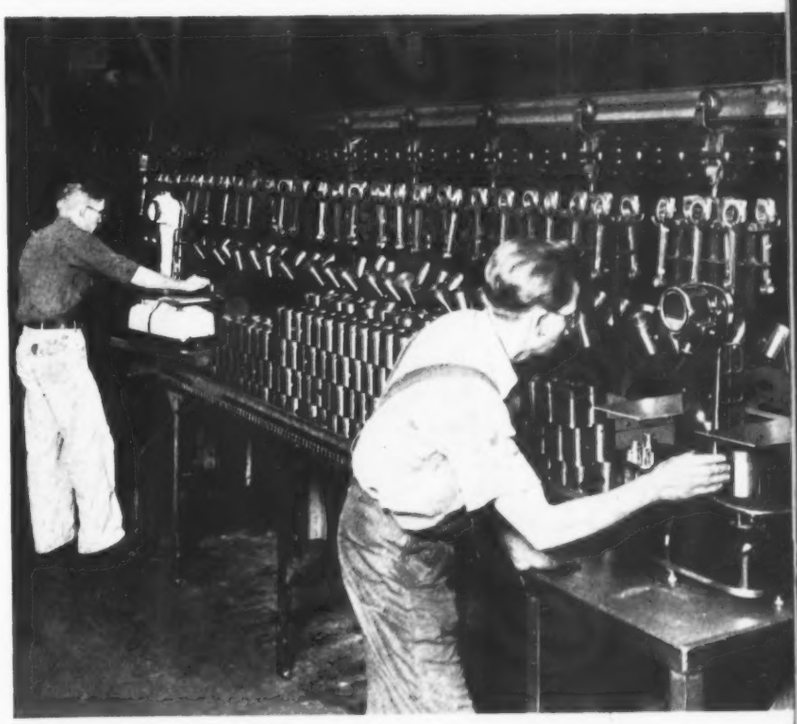
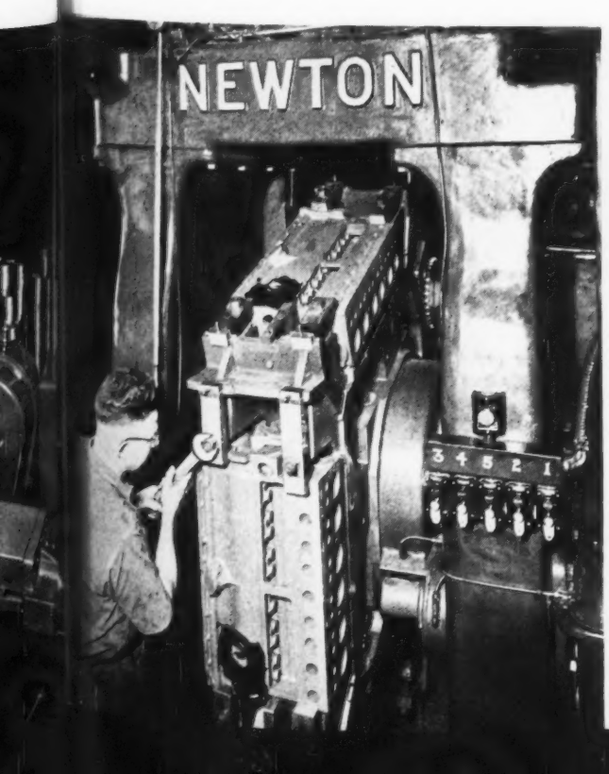
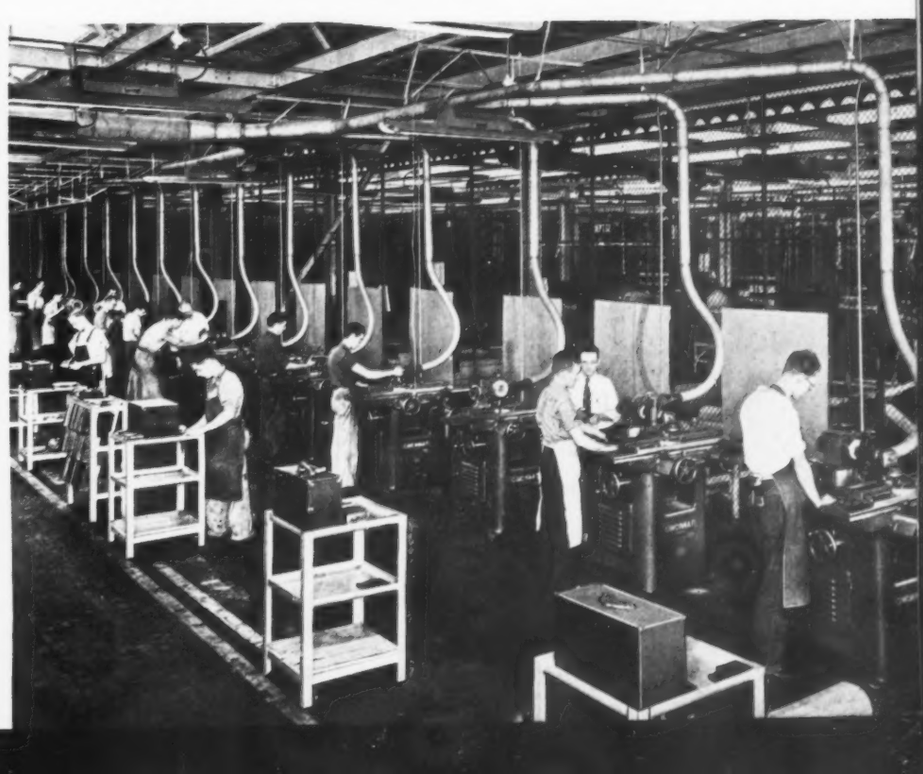


Fig. 13. (Below Left) The Top and Bottom of Cylinder Blocks are Rough- and Finish-milled on a Newton Rotary Milling Machine Equipped with a Five-station Fixture. Two Cutters on Each Side of the Machine at the Rear Rough and Finish the Surfaces as They Pass by

Fig. 14. (Below Right) Seventeen Cincinnati Universal Tool Grinders have been Installed in the Tool-room for Grinding Cutting Tools of Various Sizes and Shapes. An Overhead Exhaust System Carries away All Dust Particles which Might be Injurious to the Machine Operators





Farm Tractors Built by the

ARDUOUS labor on large farms has been greatly reduced for some years by the use of tractors. On farms of small acreage, however, the cost of a tractor has been too high to make it a paying investment, and as a consequence, a man owning a modest farm has been compelled to plow, harrow, and perform other back-breaking tasks with horses. Even on a farm of forty acres that is kept under complete cultivation it is necessary to turn over at least 40,000 tons of earth annually. This has made the small farmer "tractor conscious." To supply the needs of this potential market, the Allis-Chalmers Mfg. Co. has just added to its line a Model B tractor that sells for $495 f.o.b. Milwaukee—not a great deal more than the cost of a good pair of farm horses. These small tractors, and also the next larger size, are being produced in a completely new plant in Milwaukee which is at present turning out 200 tractors a day. The latest manufacturing methods are employed in this shop, as will be apparent from the illustrations in this article.

The manufacturing procedure has been planned on the principle that adherence to close tolerances is most economical, because it saves time and eliminates trouble in assembling operations. Parts are checked with gages before they are taken away from any machine, 100 per cent inspection being practiced in almost every machine operation. The point is emphasized by the management that it is due only to stringent application of this rule that tractors of high quality can be sold at the low price mentioned.

Cylinder heads are milled on the top and bottom, and cylinder blocks on the ends, in the Niles drum type milling machine shown in Fig. 1. The rotary drum is provided alternately with two types of fixtures, one being designed to hold a cylinder block crosswise on the drum, as shown, while the other is designed to hold cylinder heads on both sides of the drum, first on the right-hand side for milling the top and then on the left-hand side for milling the bottom. Two cutters, the larger 14 inches in diameter, are mounted on each side of the machine.

Latest Manufacturing Methods

All holes in the cylinder heads, including the angular spark-plug holes, are drilled by the Natco multiple-spindle machine shown in Fig. 2, which is equipped with two hydraulically operated heads that slide on horizontal ways of the bed. Each cylinder head is placed in four stations of the jig, in the two bottom ones the top and bottom sides of the cylinder head are held in vertical planes; in the next, horizontally; and in the last (at the top), angularly. The cylinder heads are placed in the bottom station by means of dogs on a chain that is actuated by a crank-handle. Clamps operated by crank-handles hold the cylinder heads firmly in the various stations.

Six oil-holes are drilled simultaneously in crankshafts on an Avey machine equipped with single-spindle hydraulically operated drilling heads arranged at the front, back, and one end of the machine, as illustrated in Fig. 3. These heads operate on ways located in various angular positions as required for drilling through the bearings and crank-arms. The drill heads are so designed that if the load on a drill becomes excessive, due to a dull tool, too great an accumulation of chips in the hole, or a hard spot in the crankshaft, the head will reciprocate rapidly until the condition is remedied, so that the operator is immediately informed of the condition. The drill heads return automatically to the starting position after an operation.

The four holes in crankshaft flanges are drilled, chamfered, and tapped in three stations of the Rockford indexing type multiple-spindle machine shown in Fig. 4. Drilling occurs in the first station at the front, chamfering in the bottom station and tapping in the rear station. The work drum is locked in the various settings by a plunger that enters bushings provided in arms of the fixture. The crankshafts are reloaded in the uppermost fixture position.

A two-way W. F. & John Barnes machine for boring final-drive housings is illustrated in Fig. 5. Five bores are finished in each casting by this machine, which also cuts grooves in three of the bores, and faces one surface.

Fig. 1. Drum Type Milling Machine that Finishes the Ends of Cylinder Blocks and the Top and Bottom of Cylinder Heads for Tractors

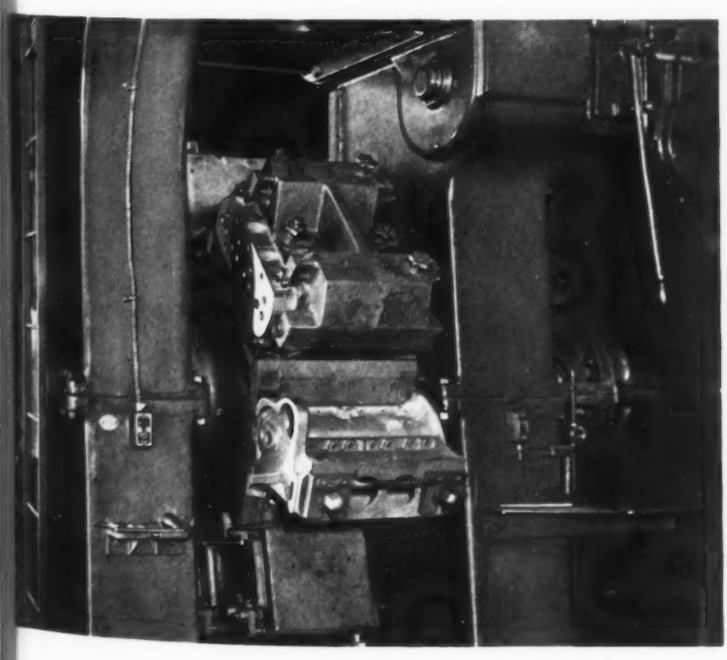
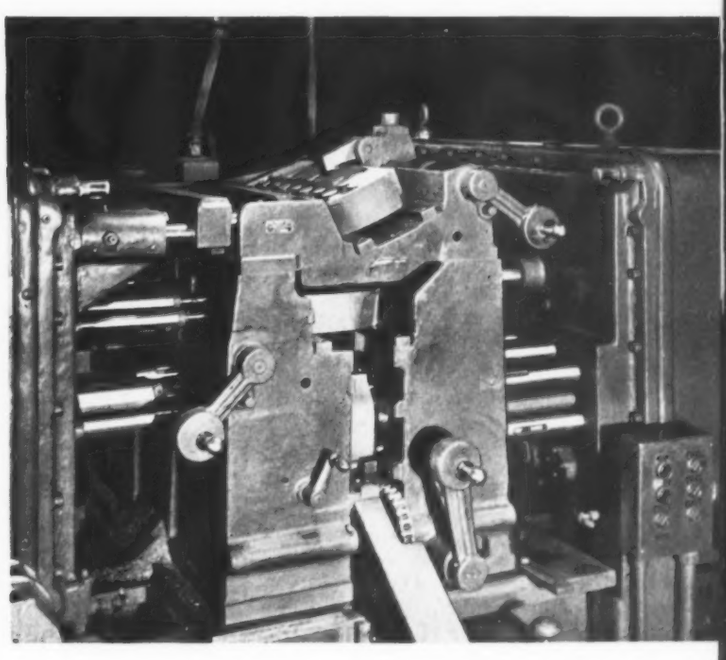


Fig. 2. Four-station Multiple-spindle Drilling Machine which Drills All Holes in the Tractor Cylinder Heads with Two Machine Heads



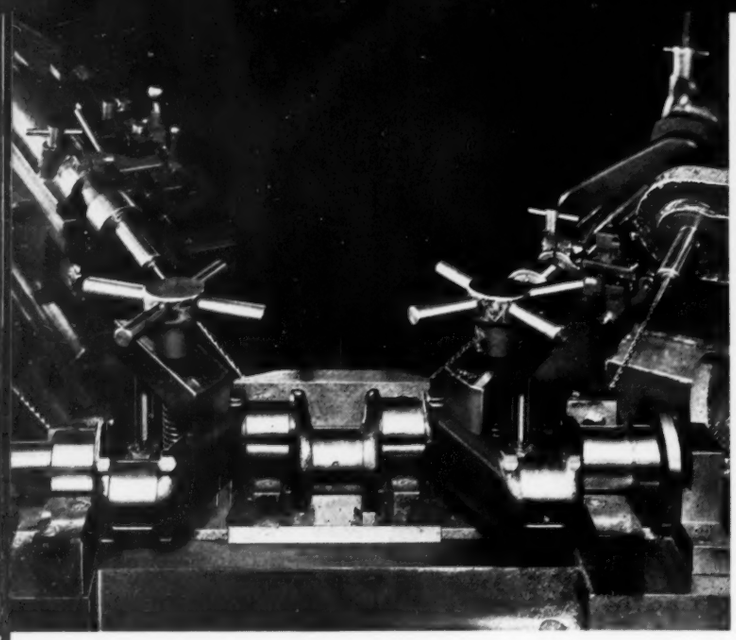


Fig. 3. Six Oil-holes are Drilled Simultaneously in Crankshafts by Independent Hydraulic Heads

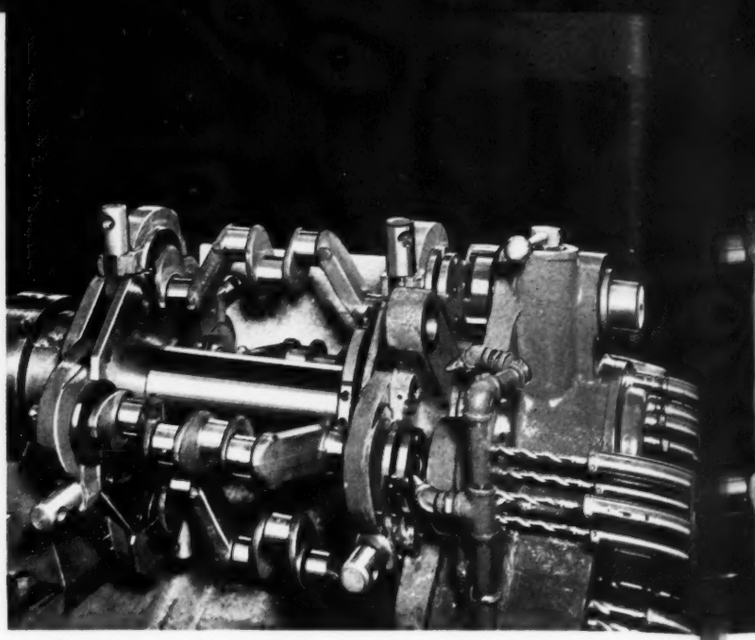
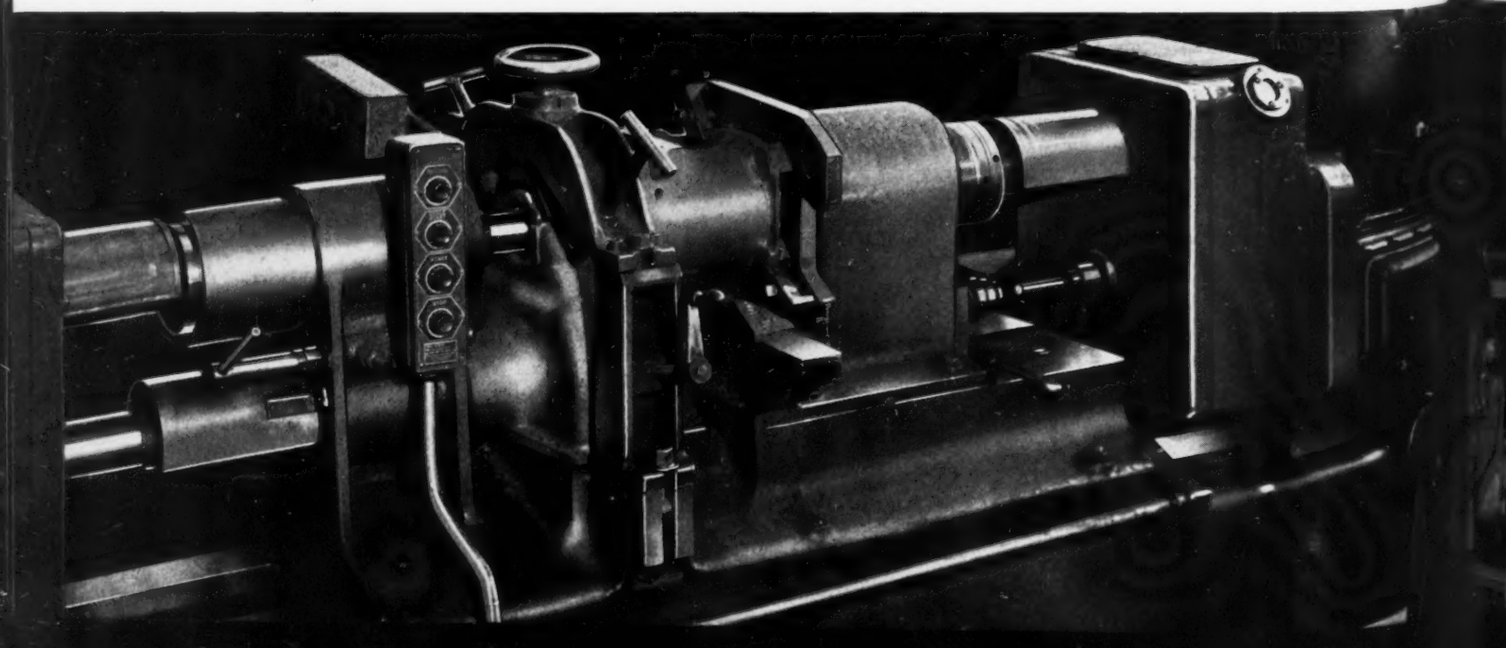


Fig. 4. Machine Designed for Drilling, Chamfering, and Tapping Four Holes in Crankshaft Flanges

BUILDING ALLIS-CHALMERS

In operation, the two heads feed forward for taking the boring and facing cuts, and then the left-hand head remains stationary while the right-hand head keeps advancing. After this movement is completed, the front end of the upper boring-bar of the right-hand head enters the upper boring-bar of the left-hand head, causing the tools on the latter boring-bar to expand radially for cutting one of the grooves. At the same time, the adjustable rod seen extending from the lower portion of the right-hand head, enters the lower boring-bar of the left-hand head and causes the tools on that boring-bar to expand for cutting the other two grooves. The relative location of the grooves on the two center lines of the casting must be held within plus or minus 0.002 inch. This accuracy is readily obtained

Fig. 5. Final-drive Housings have Five Bores Finished in This Machine and Three Grooves Cut in the Bores. In Addition, a Surface is Face-milled



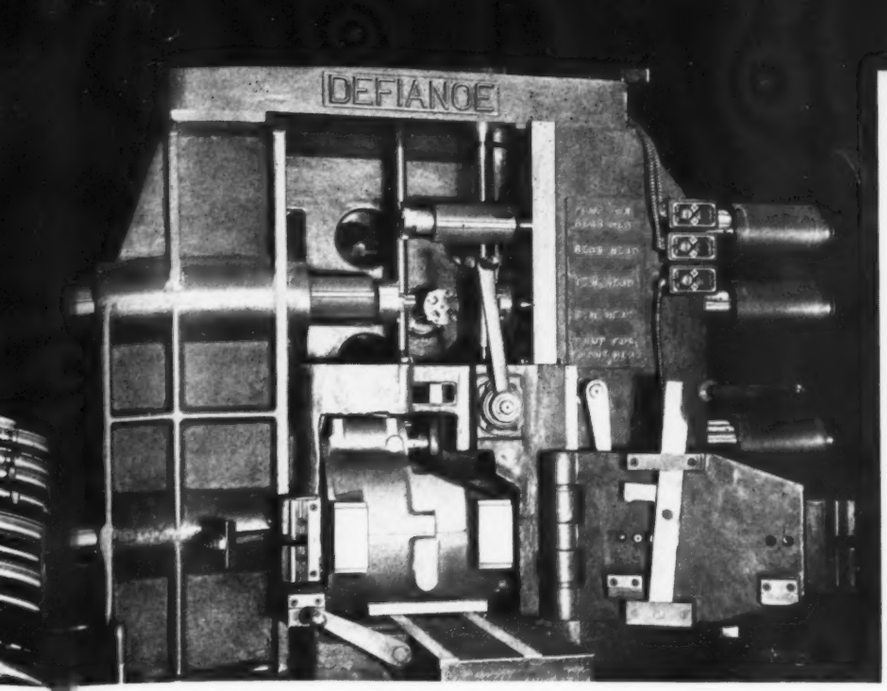


Fig. 6. Clutch Housings are Rough- and Finish-bored Complete in the Two Stations of This Machine

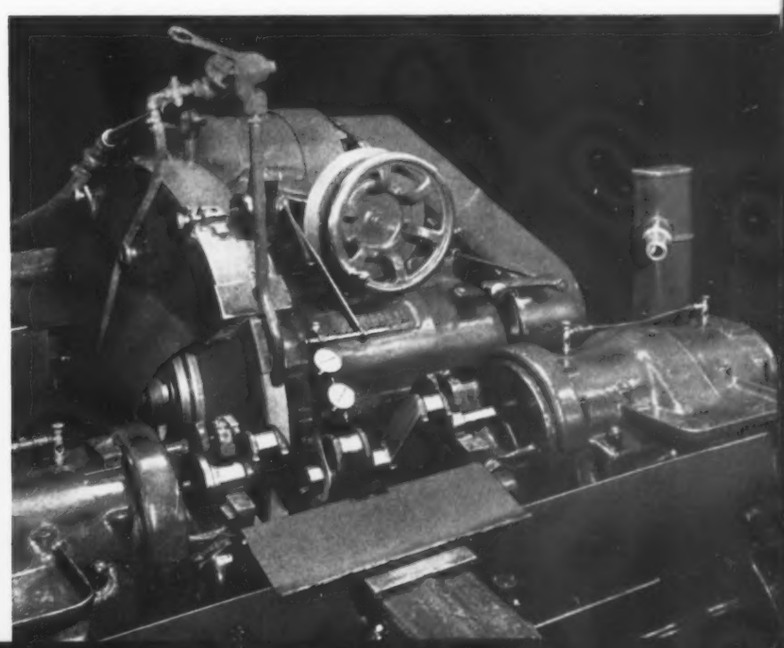
Fig. 7. Cylinder Liners are Precision-bored, and afterward Honed

through the adjustable rod on the right-hand head. The machine is operated entirely by hydraulic power.

Clutch housings are rough- and finish-bored complete in the two stations of the special Defiance machine illustrated in Fig. 6. With the casting in the lower station of the machine, as shown, the hinged jig cover is closed and locked for properly positioning the casting. Then heads advance from the left, right, and back of the machine for rough-boring five holes and two counterbores and facing a surface of small diameter by means of an end-mill. The work fixture is next automatically elevated to the upper station of the machine, where all of the surfaces roughed in the preceding step are finish-bored, counterbored, and milled.

Fig. 8. Thirty Holes are Tapped Simultaneously in Cylinder Blocks by the Machine Here Shown

Fig. 9. Finish-grinding the Crankpins of Crankshafts to Size and Round within 0.00025 Inch



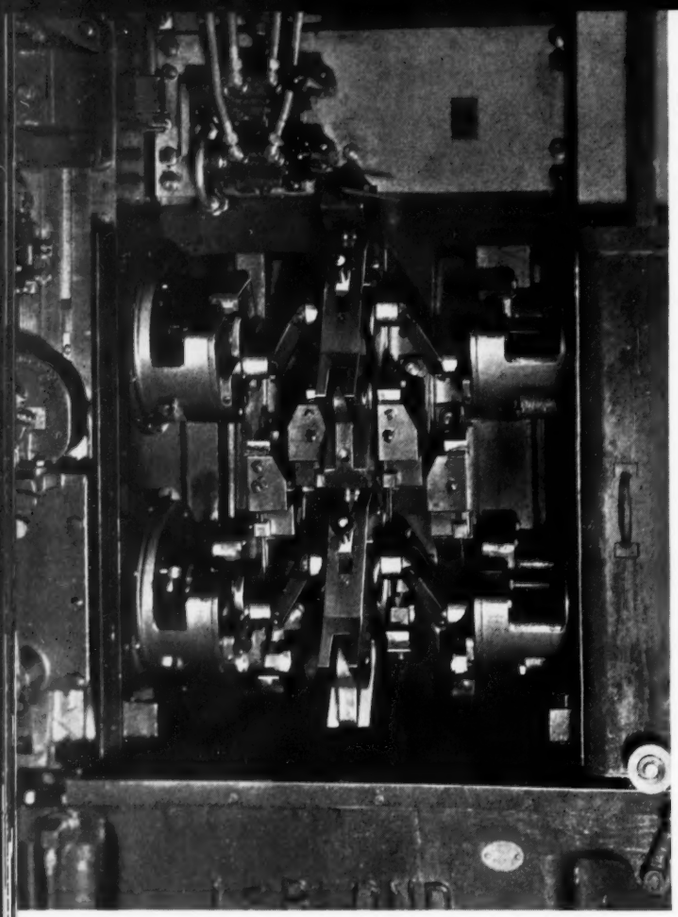
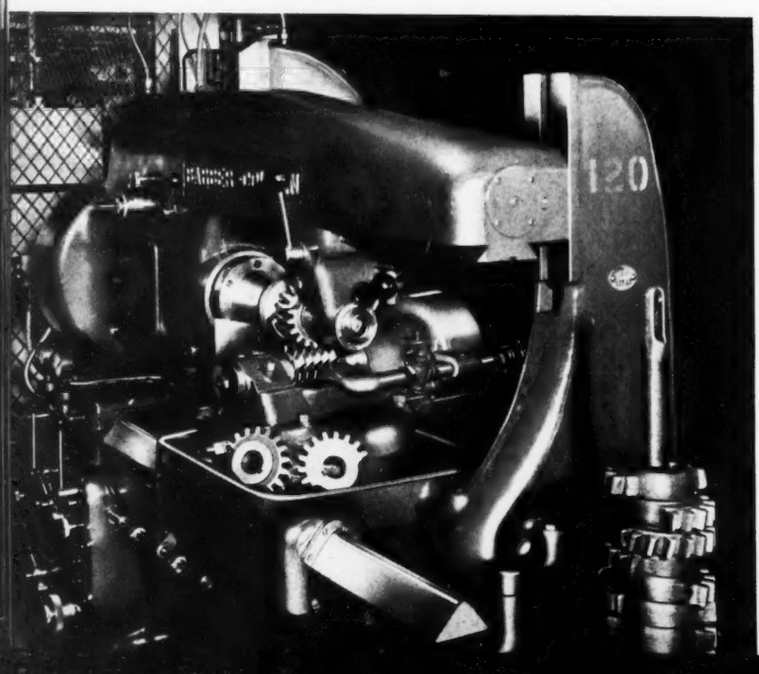


Fig. 10. The Crankpins of Crankshafts are Rough-turned in the Bottom Station of This Machine and Finish-turned in the Upper Station

Fig. 11. Gear-hobbing Machine Employed for Cutting the Teeth of Four Steering-gear Segments in One Operation



After having first been rough- and finish-bored, cylinder sleeves or liners are precision-bored with tungsten-carbide tools on machines of the type shown in Fig. 7, built by the Brust Tool Mfg. Co. Each machine is equipped with a duplex fixture that slides back and forth on the table beneath the boring spindle, thus enabling one cylinder liner to be loaded while another is being bored. The boring-bar is free-floating, so as to allow the tool to follow the bore previously machined. The work is fed upward past the boring tool and comes from this machine true within 0.0005 inch for straightness, roundness, and diameter.

The cylinder liners are then transferred to a honing machine for two operations. In the first, from 0.003 to 0.004 inch of stock is removed, and after a number of liners have gone through this operation, they are honed a second time, approximately 0.0005 inch of stock being removed. When the second operation on the liners is completed, the diameter is between 3.2495 and 3.2505 inches, the length being approximately 6 1/2 inches. The tolerance for straightness and roundness, in this case also, is 0.0005 inch.

The honing operations are expedited by the use of a two-fixture table that enables one liner to be loaded while another is being honed. The operator merely drops the liners into pot type fixtures, and slides clamps over the top to hold them in place.

Thirty holes are tapped simultaneously in cylinder blocks on the Greenlee multiple-spindle machine illustrated in Fig. 8. There are twenty-two tapping spindles on the upper head, which moves downward automatically after the cylinder block has been pushed into the fixture. At the same time, the rear head, equipped with eight additional tapping spindles, advances. All of the crankshaft, bearing-stud, oil-pan, valve-cover, and oil-pressure plunger holes are tapped in this one operation.

The main bearings of crankshafts are rough- and finish-turned in LeBlond crankshaft machines, after which the crankpins are rough-machined in the bottom station of the double machine shown in Fig. 10, and then finished in the upper station. The main bearings and crankpins are next ground in Landis machines of the type shown in Fig. 9, which are equipped with Arnold gages to insure that the bearings are ground to size and round within 0.00025 inch. The width of the bearings is also held to close limits, and checked by one of the dial gages seen in the illustration, the other gage, of course, being used to obtain readings on the diameter. Crankpins are being ground in the operation

illustrated. After this operation, the crankshafts are balanced within 2 ounce-inches.

A Sundstrand rotary type of milling machine is used for finishing the joint surfaces of connecting-rods and caps. This machine is equipped with a fixture, as shown in Fig. 12, on which rods and caps are mounted alternately with the joint faces upward, so that they are finished as they pass under an end-mill attached to a vertical spindle. The connecting-rods are located lengthwise from the previously reamed piston-hole, and sidewise from the milled boss faces. The caps are also located from previously milled surfaces.

This tractor plant includes a large gear-cutting department, in which almost every type of gear-cutting machine is found. There is also a glass-enclosed inspection room with complete equipment for checking the gear-tooth elements of every type of gear produced. This room has greatly improved the quality of work turned out by the machines by detecting inaccurate hobs and other cutters.

A Barber-Colman machine used in the gear-cutting department for hobbing the teeth of steering-gear segments is shown in Fig. 11. The segments are mounted on the work-arbor, four at a time, in such a manner that the hob cuts around a complete circle instead of around the length of one segment only.

The tractors are assembled along moving conveyor lines, in accordance with the highly efficient methods found in the most modern plants of the automotive industry. At the end of each final assembly line, the complete tactor, except for the rubber tires, passes through booths in which hot water, steam, and a lye solution are directed over it to remove all grease and dirt. Then the tractor passes through paint spraying booths arranged, as shown in Fig. 13, with a curtain of water falling constantly at the back of the booth, the water carrying away all excess paint and eliminating odors. Finally, the tractor passes through a long drying chamber, at the end of which the rubber tires are put on. It is then driven on a freight car under its own power, and blocked for shipment to all parts of this and foreign countries.

Fig. 12. Rotary Milling Machine Employed for Machining the Joint Faces of Connecting-rods and Their Caps, which are Loaded Alternately around the Fixture

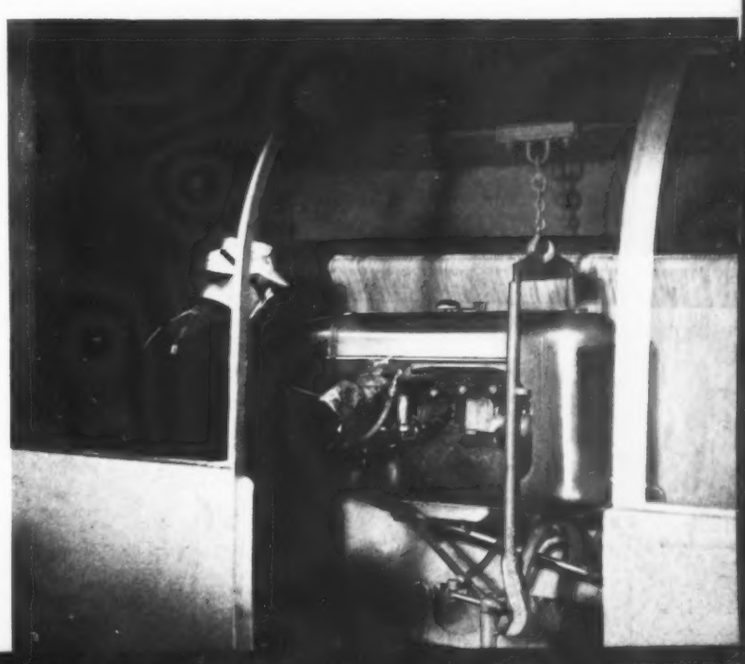
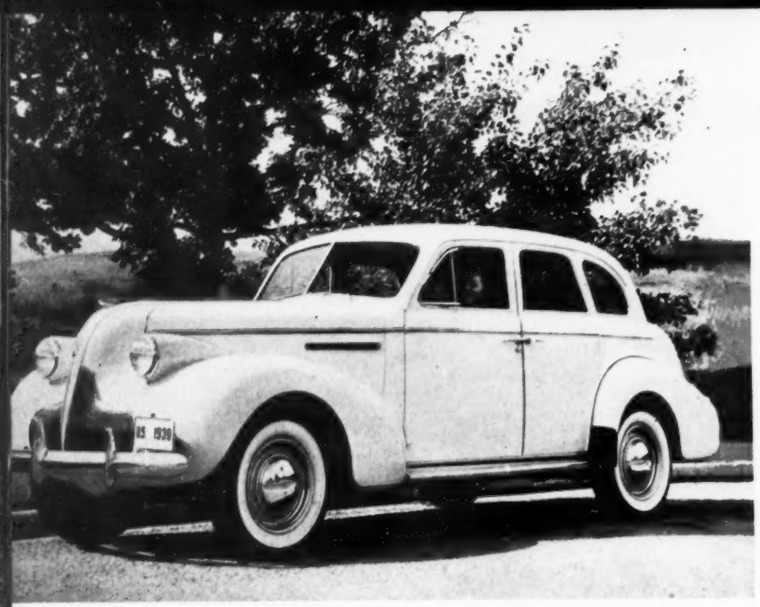


Fig. 13. View of a Paint Spraying Booth, Showing Curtain of Water that Carries away Excess Paint and Eliminates Odors



New Equipment

THE 1939 Buick automobiles are not merely exponents of advanced streamline styling; they also have new mechanical features, noteworthy among which is a transmission that has been completely redesigned in harmony with a remote-control gear shift under the steering wheel that supplants the time-honored "wobble stick."

From an engineering and production standpoint, the important change in the transmission is the simplification of the shifter forks and the mechanism required for making gear changes with the new control. It was also found possible to reduce the over-all length of the transmission case without in any way affecting the load-carrying capacity of the transmission.

The transmission case itself is being finished on essentially the same types of machines as heretofore, although some important changes have been made in the tools and fixtures used. Many basic changes have been made, however, in other manufacturing practices of the transmission plant, including the installation of a large battery of surface broaching machines for finishing various gear-shift parts.

While the gears remain essentially the same, major changes and improvements have been effected in their manufacture. Last year it was found possible to produce quality gearing in two operations, one performed on a gear-cutting machine and the other in a rack type finishing machine. At that time, the countershaft gear could not be handled in the same manner, due to its particular size and shape. However, a design change has now enabled the production of the teeth on the countershaft gears also to be completed in two operations.

Further simplification of the machining problem on the countershaft gear was effected through the broaching of three long grooves in the bore during the first operation performed on this gear. These

Fig. 1. Broaching Machine and Mult-Au-Matics which Machine the Second-speed Gear Blanks Ready for the Tooth-cutting Operations

Fig. 2. Close-up View of Bullard Mult-Au-Matic which Bores, Turns, and Centers the Gear End of Buick Clutch Drive-gears

for Making New Buick Transmissions

grooves are used to hold the gear in subsequent machining operations, thus eliminating the need for special expanding work-holders, and simplifying machining set-ups.

The gear machining departments of the transmission plant have been considerably condensed by the elimination of many machines formerly necessary, thus making available considerable floor space for other production requirements. The machine line for the first-speed and reverse gear is a typical example of the manufacturing advances made. All of the finishing operations on this gear blank are now performed on Bullard vertical automatic lathes, after the first broaching operation. The second-speed gear is turned and faced on the Bullard Mult-Au-Matics seen in Fig. 1 after the part has been broached in the Oilgear machine seen at the left. With this practice, the number of machines required for this work has been reduced, as well as the number of separate handlings of the gear blanks. A close-up view of an eight-spindle Bullard Mult-Au-Matic used for boring, turning, and centering the clutch drive-gear is shown in Fig. 2.

Internal gear teeth are cut on Fellows gear shapers, as illustrated in Fig. 3, and external gear teeth are produced on hobbing machines. In each case, however, there is only one gear-tooth cutting operation, after which the finishing of the teeth is accomplished on Michigan rack type shaving machines, as shown in Fig. 4.

Outstanding examples of surface broaching include the machining of the gear-shifter shoes and the several shifter levers. It would be almost impossible to produce the contours required on these parts by other methods without resorting to a multiplicity of set-ups. The final and most important operation on the first and reverse shifter shoes for the Buick 40 transmission, prior to heat-treatment, is the broaching of the shifter slot and two adjacent pads. These cuts are all taken by a Colonial vertical broaching machine equipped, as shown in Fig. 5, with a four-station work-holding fixture. The illustration shows the shifter slot being broached in two pieces held in the left-hand side of the fixture at the same time that two pads are being finished on parts held in a different position in the right-hand side of the fixture.

In broaching the second- and third-speed shifter shoe, a part circle is finished in the shifter-pad

Fig. 3. Fellows Gear Shaper Cutting Internal Teeth on a Clutch Drive-gear, a Gear Blank being Seen at the Left Front of the Machine

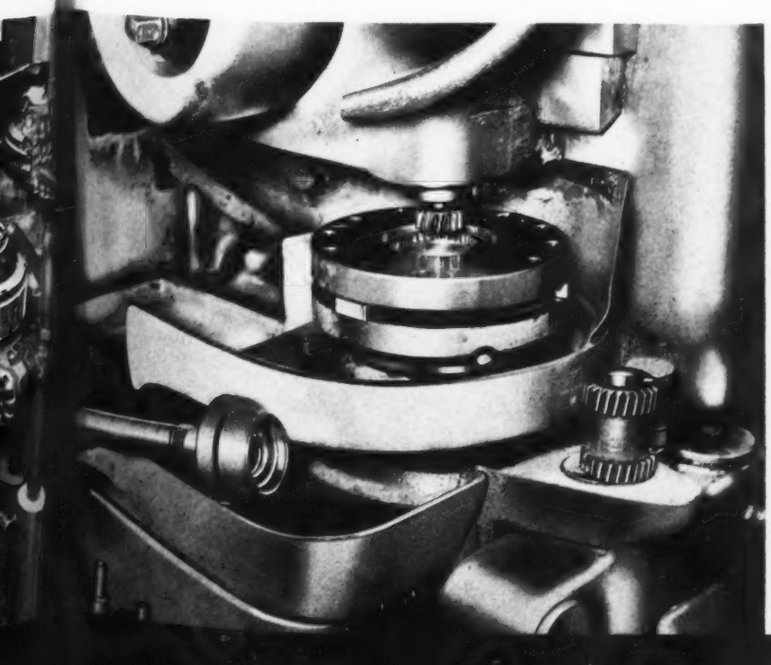


Fig. 4. All Transmission Gear Teeth are Finished on Michigan Rack Type Shaving Machines after a Single Shaping or Hobbing Operation

throat, and two bosses are finished at the same time. The fixtures shown in Fig. 6 were designed for holding two shoes at a time in such a manner that practically a half circle is presented to a circular broach. Consequently, one pass of the broach produces the desired circular form on the two shoes. At the same time, broaches to the right and left of the circular broach finish bosses on one side of each part. Two pieces are thus completed with each cycle of each ram, duplicate broaches and fixtures being provided, of course, on the two sides of the machine.

From the standpoint of mechanical ingenuity, the most interesting boaching operations are those employed for machining the first and reverse shifter levers, of which several sizes are shown in Fig. 7. Owing to their unusual shape, it was found necessary to use two broaching machines for these parts. The first operation is performed on an American rotary type of broaching machine, a close-up view of which is shown in Fig. 8. The broaches of this machine are arranged on a head that extends around the table, except at the front, which is left open for reloading. The broaches are composed of a number of separate segments, arranged around a circular arc. Twenty-eight work pieces are accommodated at one time on the table, which is equipped with two different types of fixtures, fourteen of one kind, and fourteen of the other.

When the part is set up in fixtures of the type seen in the immediate foreground in Fig. 8, the two large flat surfaces on the examples at the left in Fig. 7 are broached as the parts pass around the machine, as well as the narrow step between the two larger surfaces. When the parts again reach the front of the machine, they are transferred to the second type of fixture shown in Fig. 8, for broaching a flat spot on the lock-screw boss, as seen on the examples at the right in Fig. 7. This surface is broached during a second passage of the work around the broaches. In both set-ups, the part is located from the previously machined bore, thus insuring that the finished surfaces will be accurately machined in relation to each other.

The cam on the shifter pad at the top of these levers, as seen in Fig. 7, has a curve on both sides that would present a difficult machining problem if the cam were finished by means other than broaching. This shifter-pad contour is being finished on a Cincinnati vertical duplex broaching machine, to which the parts are routed from the rotary broaching machine. The vertical machine is equipped with two fixtures, as seen in Fig. 9, four parts being broached in one of the fixtures while the other one is being reloaded.

Fig. 5. Vertical Surface Broaching Machine which is Used for Machining a Slot and Two Pads on First and Reverse Shifter Shoes

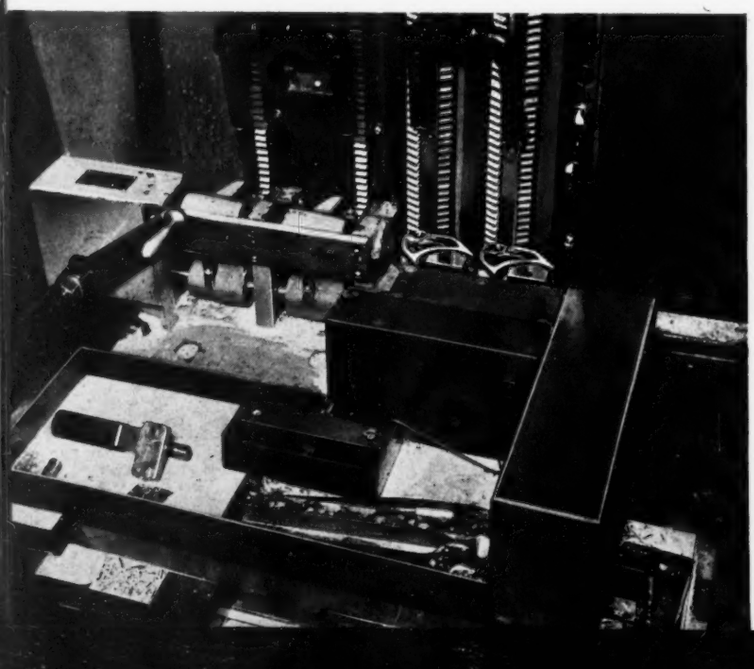
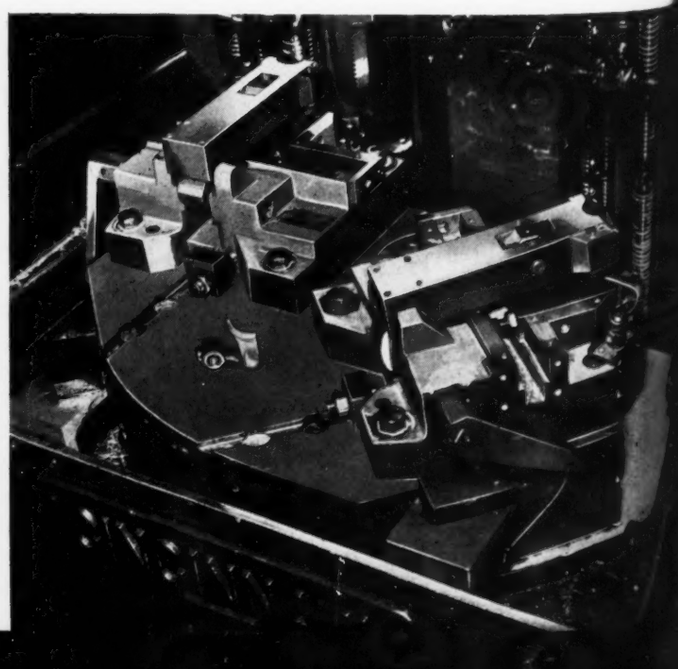


Fig. 6. Broaching Tools and Fixtures Used for Finishing Several Surfaces of Shifter Shoes Such as Seen at the Left Front of the Fixture Base



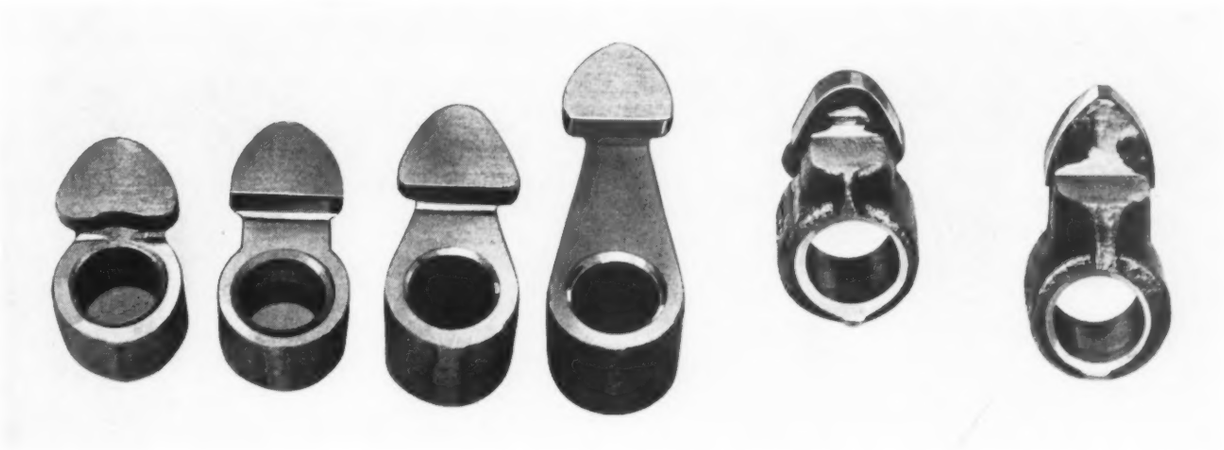


Fig. 7. Shifter Levers which are Finished by Broaching on the Large Flat Surfaces of the Examples Seen at the Left, on the Step between These Surfaces, on the Lock-screw Boss Seen on the Right-hand Examples, and around the Cam at the Top of These Parts

The rather complex cam surface must be produced in two separate cuts, one side of the cam being broached with the part held in one position in the fixture, after which the part is transferred to another position in the fixture and the second side finished. Two parts are completed with each stroke of either ram.

The use of these broaching machines marks an important milestone in the manufacture of shifter shoes and levers. They have furnished a simple and economical solution of the problem of finishing a variety of contours and surfaces on these somewhat intricate work pieces that are required in automobile transmissions.

Fig. 8. Close-up View of the Rotary Broaching Machine Employed for Finishing the Various Flat Surfaces of the Shifter Levers

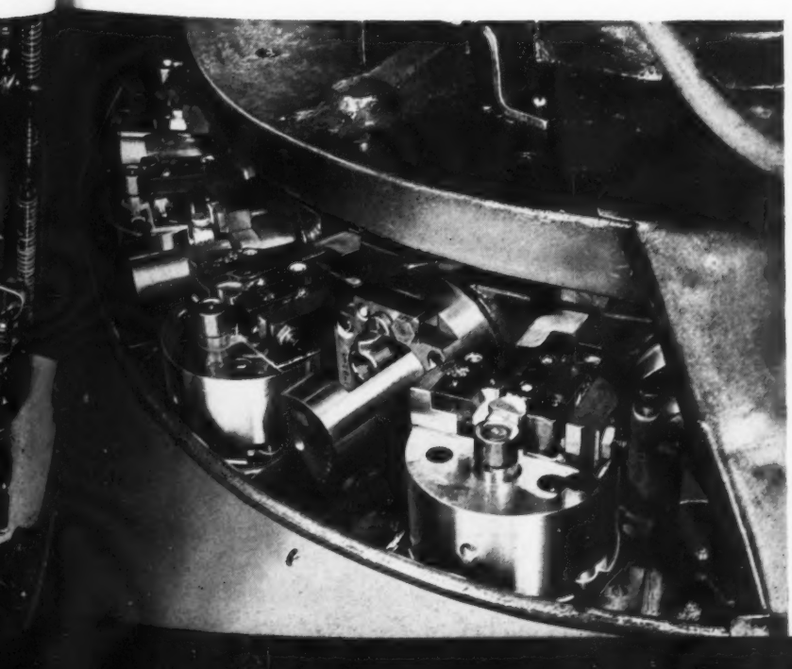
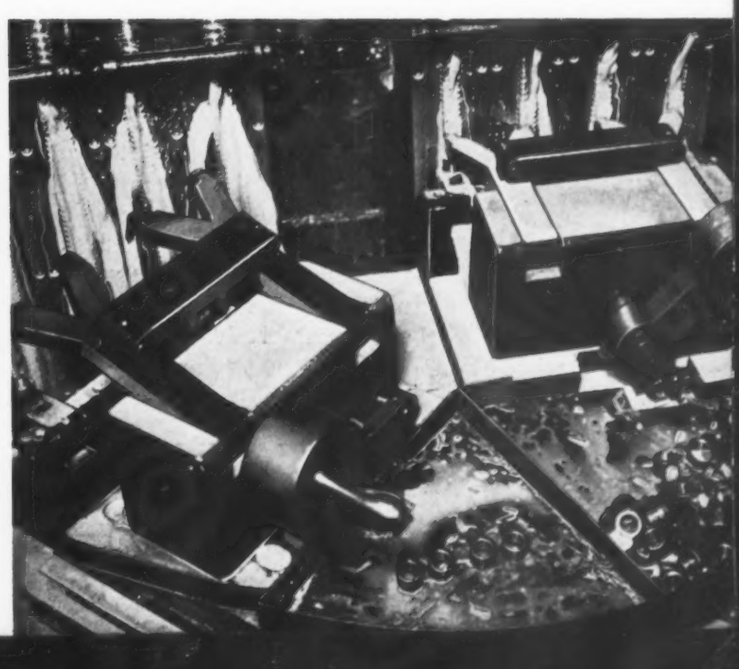


Fig. 9. The Broaches and Fixtures Used for Finishing Both Sides of the Cams on the Shifter Levers Illustrated in Fig. 7



Producing Fenders in DeSoto's

By J. F. HUGHES, General Superintendent
DeSoto Stamping Plant, Detroit, Mich.

THE manufacture of automobile fenders is a vastly different proposition from what it was in the early days of the industry. In those days, the fenders were shaped by merely rolling steel stock to the required width through machines, in order to bend it to the desired contour, and then riveting a narrow ribbon of steel around the fender edges for the sake of strength and appearance. Rivet holes were drilled in the fenders, on the theory that piercing would result in cracking the metal surrounding the holes.

Today the shaping of fenders requires the use of huge presses capable of exerting pressures of more than a million pounds, in order to draw the fender metal to the great depths and unusual contours demanded in the comparatively narrow sheets of stock. Stampings that would formerly have been considered impossible and which as recently as last year were made by drawing two pieces of steel and welding them together, are now being made in one piece. The handling of the raw material, parts in process, and finished fenders is also an important problem, in view of the heavy production schedules.

The DeSoto Stamping Plant of the Chrysler Corporation, Detroit, Mich., is one of the most modern in the world, having been erected only two years ago along architectural lines that enabled an especially efficient lay-out of machines, work-handling conveyors, cranes, etc. Nearly 40,000 windowpanes insure adequate lighting in the day-time and high-intensity mercury lamps give virtually as much light at night.

This plant is equipped with the latest types of presses and other machines for the production of

Stamping Plant

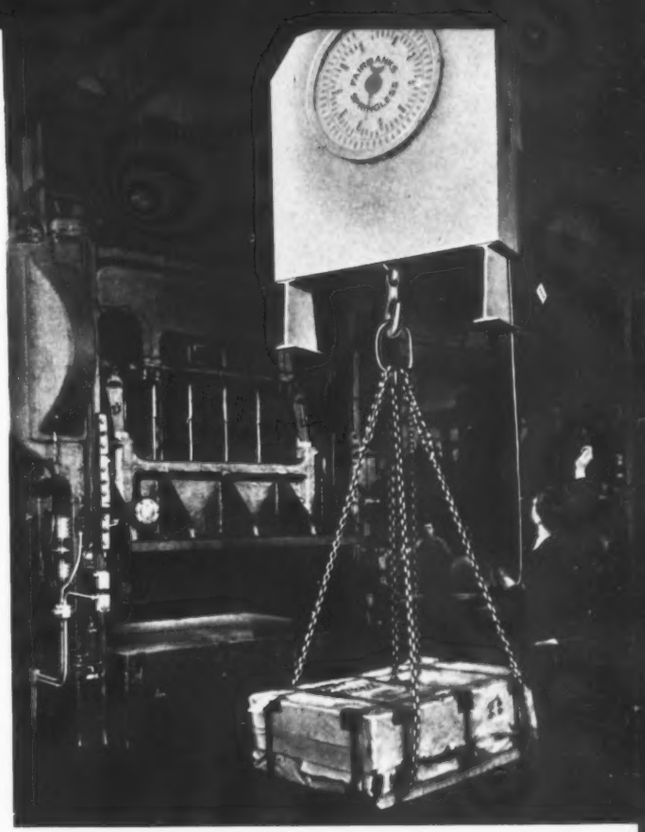


Fig. 1. Crane Scale which Furnishes a Printed Ticket Showing the Weight of Skids and Coils of Sheet Steel

Fig. 2. Cradle Reel, Sheet Leveler, and Feeding Unit Used for Feeding Coil Stock to a Fender Blanking Press

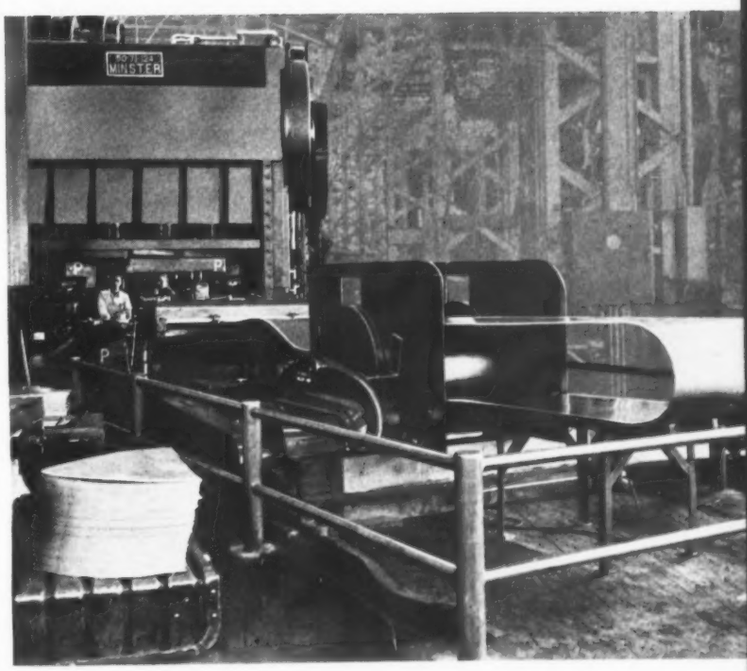


Fig. 3. Two Shearing Machines Arranged for Simultaneously Cutting Sheet-steel Blanks for the Drawing of Hood Tops

fenders, radiator shells, hood tops, side panels, oil-pans and smaller stampings. Forty-four additional presses have been installed this year to meet 1939 production requirements. The heading illustration shows an imposing line of the newest presses, consisting of six 250-ton crankless type presses, which are used for trimming and flanging operations on fenders, and two 625-ton drawing presses, weighing over 350,000 pounds each.

In the average stamping plant, considerable time is required for maintaining an inventory of the stock on hand. It is the usual practice to unload the bundles and coils of stock from freight cars, transport them to scales for weighing, and then truck them to storage spaces. The stock is then transported to a press for fabrication into products.

When the DeSoto Stamping Plant was built, a scale manufacturer was asked to provide a 10-ton crane scale by means of which the skid or coil of stock could be weighed while it was being taken off the gondola cars. This scale, which is shown in Fig. 1, ejects a ticket with the weight of the load printed on it when the stock clerk presses the button of a pendent switch, as shown in the illustration. The clerk presses the button, and the moment that the coil or skid of stock stops swinging, the ticket is ejected.

The gondola cars are pushed along a track right into the shop in line with the rows of presses, and the stock is transferred from the cars to the adjacent storage platform at the head of the press lines. Thus the transfer of stock from the freight cars to the press lines is often as short a distance as 9 feet and never more than 50 feet. The crane has a span

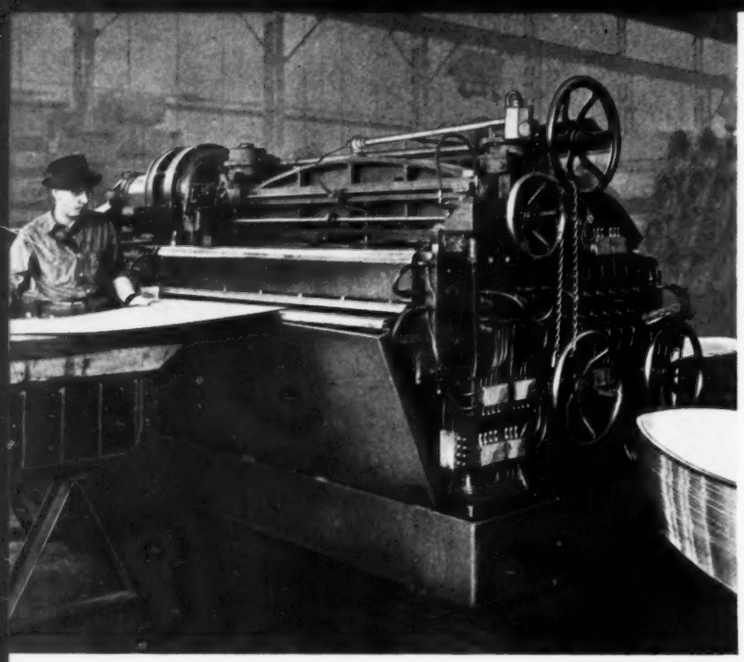


Fig. 4. Roller Leveling Machine through which Flat Steel Sheets are Passed in Order to Eliminate Strains

of 77 feet. In handling from 250 to 400 tons of sheet steel per day, the crane scale has proved a great convenience in maintaining stock records.

Coil stock is used for the production of rear fenders, radiator shells, and hood tops. In shearing fender blanks of the required dimensions. the coils, which weigh approximately 7000 pounds, are mounted in a cradle reel, as shown in Fig. 2. As the stock is uncoiled by this device, it forms a loop toward the back, as illustrated, until the bottom side of the loop rides over an electric switch and shuts off the current to the motor that drives the reel. Then the loop of stock is quickly pulled forward through the rolls of the combined straightening and feeding unit located between the cradle reel and the press, and pushed into the blanking dies of the press. From 30 to 100 inches of stock is fed forward at a time. As the feeding action occurs, the motor of the cradle reel is again started up automatically to get another loop of stock ready for the next operation of the press.

The double-action blanking press employed for cutting fender blanks has a capacity of 250 tons, and is operated approximately 300 strokes an hour. This press measures 124 inches between uprights and 80 inches from the front to the back of the bed. The stock is fed into the dies at an angle, and two blanks are cut with each press stroke, the blanks being "nested" in order to minimize scrap. The speeds of the cradle reel and of the straightening and feeding unit are controlled hydraulically. The cradle reel, feeding unit, and press are operated by two men.

Blanks for hood tops are cut to the required dimensions by two shears, arranged in tandem, as illustrated in Fig. 3. To cut the blanks at the required angles, it was found necessary to tilt one shear and nest one end within the frame of the other shear, as illustrated. These shears operate in synchronism, and produce two blanks at a time for the drawing of two complete hood tops.

As the same shears are used for cutting blanks of different lengths to suit the production of hoods for Plymouth, DeSoto, and Chrysler automobiles, provision had to be made for readily changing the distance between the shearing knives of the two machines. Consequently, the shears were mounted on heavy boiler plate with three tapped holes provided for each of the bolts by means of which the base of the right-hand shear is fastened to the boiler plate. Three dowel-pin holes insure accurate location of the shear in the three positions. Arrows on the boiler plate, as seen in Fig. 3, indicate the positions at which the center line of this shear must be located to cut blanks of the three lengths. Two men operate the complete unit.

Sheets cut to length at the steel mill are used for the production of certain stampings. These flat sheets are run through roller leveling machines, such as illustrated in Fig. 4. They take the strain out of the metal as the sheets pass between rollers which are so set that the stock moves along with a wavy motion.

The first drawing operation on front fenders is performed by the 650-ton press seen at the head of the line in the heading illustration, which is of the double-toggle type. The blank is laid between locating gages on top of the bottom die ring, a close-

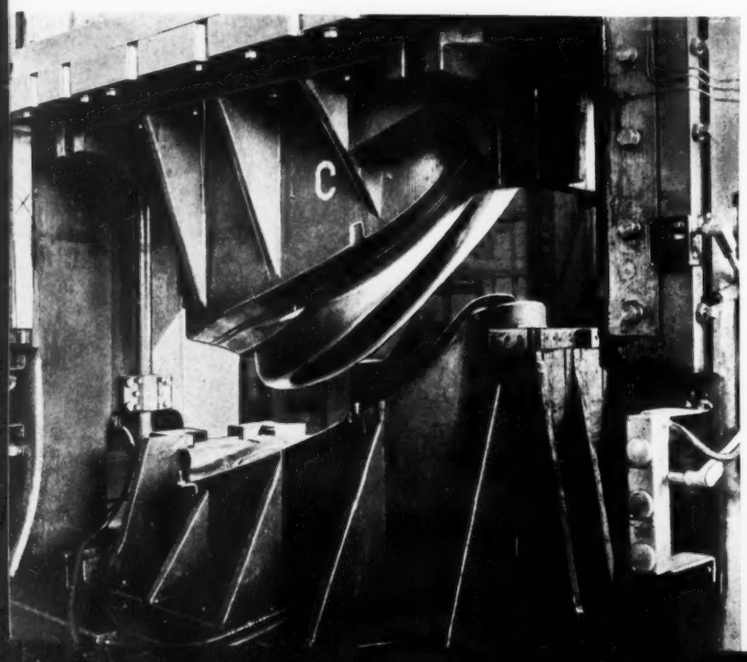


Fig. 5. Close-up View of Dies Used for Drawing a Front Fender on a Press that Exerts a Pressure of 1,250,000 Pounds

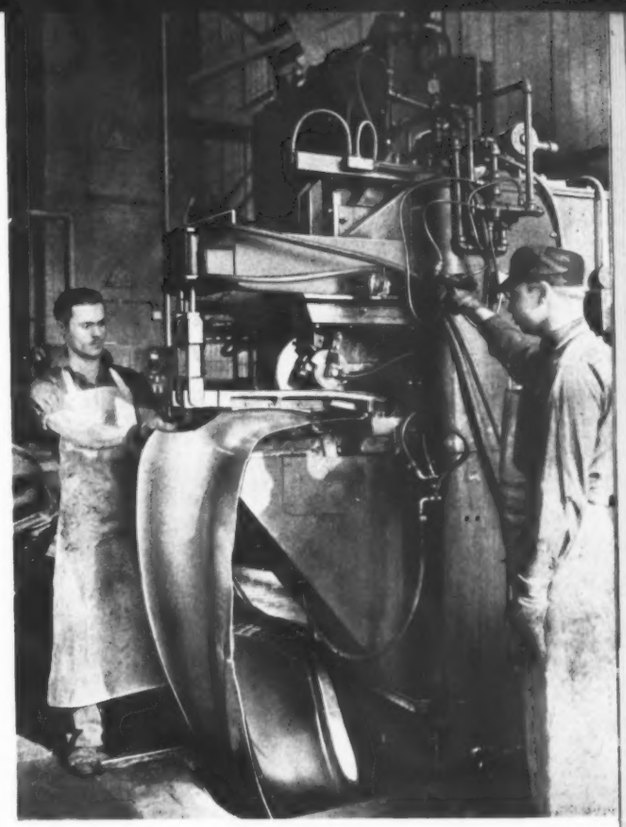


Fig. 6. Employing a Seam Welder for Attaching a Short Piece of Sheet Steel on the End of Front Fenders

up view of which may be seen in Fig. 5. When the press ram descends, the outside member of the punch or blank-holder presses the sheet along the edges of the bottom die and holds it while the center section of the punch completes its stroke and draws the fender to the desired shape. Rear fenders are drawn in a similar manner, the greatest depth of draw on these one-piece fenders being approximately 14 inches.

Excess metal is next trimmed off the fender stamping by a press, after which a piece of sheet metal is welded to one end of the fenders, in the case of Chrysler automobiles, the operation being performed by using a flash welder along one side and a seam welder along the other, as shown in Fig. 6.

Three presses of 250 tons capacity each are next employed for performing a series of seven trimming, flanging, and beading operations on the fenders. The first press of the front-fender line, a close-up view of which is shown in Fig. 7, performs two trimming operations simultaneously, there being two complete die sets. The next press, which is also equipped with two sets of dies, forms a bead on one side of the fender and performs a trimming operation. The third press, equipped with three dies, trims the headlight orifice and pierces holes for fitting the fender to the cowl.

Holes are pierced in the running board end of the fender on a 71-ton portable press. The fenders are then sent to the finishing department. The presses in the rear-fender line perform similar operations.

All of the heavy presses used in this stamping shop are erected over a basement instead of pits being provided under the individual presses, as in the older stamping shops of the automotive industry. With this arrangement, all of the under mechanism of the presses, the pressure pads, etc., are readily accessible. The individual presses are bolted on heavy steel girders that run the full length of the shop beneath the rows of presses. These longitudinal girders are supported by transverse girders and other longitudinal girders, the entire steel structure being supported, in turn, on heavy concrete piers. The basement area is approximately 240 by 130 feet.

The presses can be readily shifted to any desired positions on the upper steel girders in order to increase or lessen the distance betwcen successive presses. Concrete flooring is provided in the aisles that run along the rows of presses, but removable wooden flooring is used between the presses of each row. Thus, when dies are to be changed as, for example, in changing from the production of right-hand fenders to the making of left-hand fenders, the wooden flooring between the presses is lifted with a crane and the dies are lowered through the hole to the basement floor for storage. The dies required can be readily lifted from the storage space in the basement to the presses. Three cranes of 80-foot span and 15 tons capacity, running above the press bays, are used for this purpose.

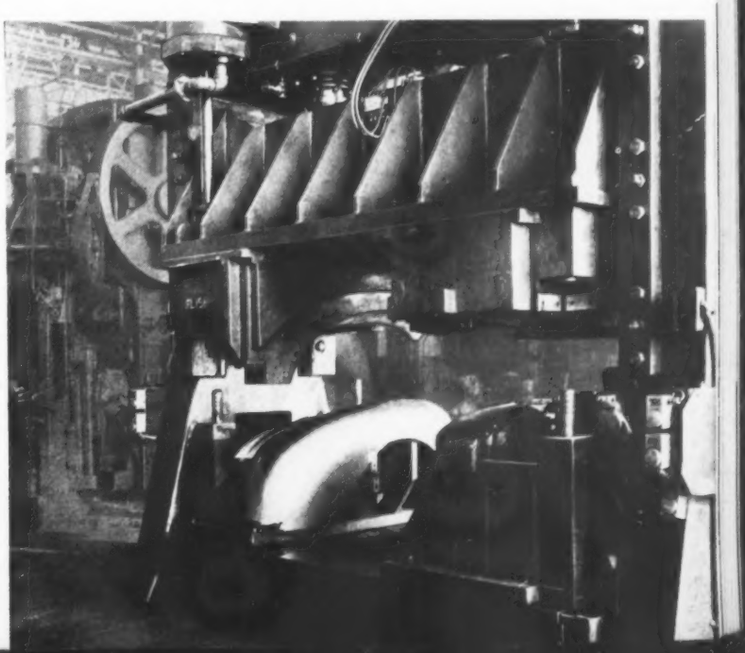


Fig. 7. Two and Three Dies are Used on Huge Presses for Simultaneously Trimming, Flanging, Beading, and Piercing Fenders

Machining Eaton

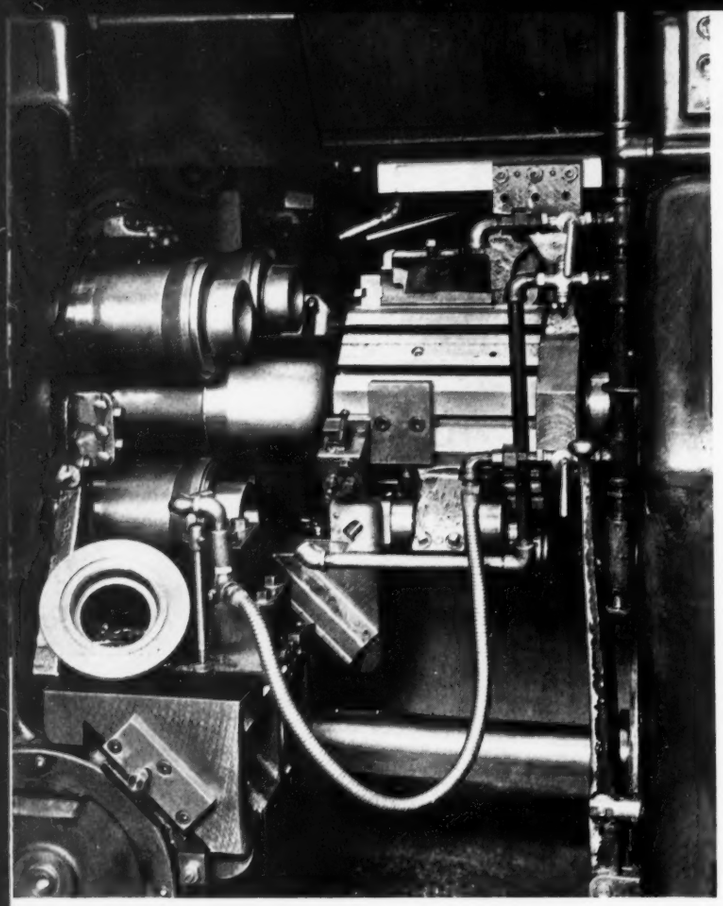


Fig. 1. Four-spindle Acme-Gridley Automatic Employed for Roughing and Finishing Both Ends of Pinion Bearing Cages

CHUCKING type turning, facing, and boring machines have been widely adopted in the high-production plants of the automotive industry because of their ability to perform a considerable number of machining operations with one handling of medium-sized work. By eliminating the need for several different types of machines, they establish large savings in floor space, labor, and initial investment. These advantages are being fully realized in the Axle Division of the Eaton Mfg. Co., Cleveland, Ohio, where approximately one hundred machines of the type mentioned are being used for finishing forgings and malleable-iron castings. Outstanding operations on several different makes of these machines will be described.

Pinion bearing cages of semi-steel are rough- and finish-machined on one end at the rate of 90 an hour in the Acme-Gridley automatic illustrated in Fig. 1. The opposite end is finished in the same machine at the same rate of production, after a slight change in the tooling has been made. In the operation shown, tools operate simultaneously at three stations of the machine, the front top station being used solely for loading. When the part is indexed to the front bottom station, a tool on the cross-slide faces and chamfers end *A* of the hub, Fig. 2. At the same time, tools on the main tool-slide rough-turn surface *B* part way and rough-bore and chamfer hole *C*.

At the rear bottom station, tools on the cross-slide finish-face end *A* and form groove *D* in the flange while tools on the main tool-slide rough-turn the remainder of surface *B* and finish-bore hole *C*. At the rear top station, tools on the main slide finish-turn hub *B* and ream hole *C*.

In the other operation on the pinion bearing cages, tools on the front bottom cross-slide rough-face sides *E* and *F* of the flange part way while tools on the main slide rough-bore and chamfer hole *G* and rough-turn the periphery of the flange. At the rear bottom station, tools on the cross-slide complete the rough-facing of sides *E* and *F* and chamfer the edges of the flange, while a tool on the main slide finish-bores hole *G*.

At the rear top station, a tool on the upper cross-

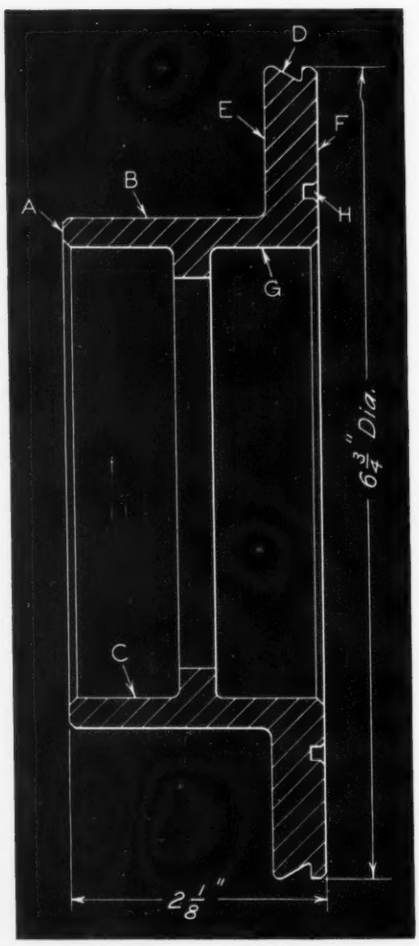


Fig. 2. Cross-sectional Drawing that Indicates the Various Surfaces Machined by the Acme-Gridley Automatic Shown in Fig. 1

Axle Parts on Chucking Automatics

slide finish-faces side *F* of the flange while tools on the main slide form groove *H* and ream hole *G*. Holes *C* and *G* are later precision-bored within a tolerance of 0.0005 inch in a Heald Bore-Matic equipped with tungsten-carbide tools. The tolerance for depth of both holes is 0.004 inch.

The operation illustrated in Fig. 3 is unique in that multiple-spindle drilling and tapping heads are employed. Another feature is a back-facing attachment for finishing a surface on the inside of the casting. The equipment is a Potter & Johnston automatic turning and chucking machine, and the work is a malleable-iron differential carrier of the construction shown in Fig. 4. Face *A* of the flange is machined and holes are drilled through the flange before the part comes to the automatic. The differential carrier is located in the automatic by pins which enter two of the drilled flange holes, and the finished face *A* is held against a hardened and ground plate on the chuck by four clamps.

Tools on the first face of the turret rough-bore holes *B* and *C*. At the same time, the back-facing tool is advanced from the headstock spindle to face side *D* of the inside bearing support. Also, a tool on the front of the cross-slide rough-faces end *E*.

Tools on the second turret face then finish-bore holes *B* and *C*, and at the same time, a tool on the rear cross-slide finish-faces and chamfers end *E*. Tools on the third turret face then ream holes *B* and *C* to size, the tolerance on both of these holes being only 0.001 inch, although the inner portion of hole *C* has a nominal diameter of 5 inches.

The seven spindles of the drill head on the fourth turret face next drill six holes of 31/64 inch diameter and one of 3/8 inch diameter in the end of the hub. The six small holes are then tapped by the multiple-spindle head on the fifth turret face.

Ingenious mechanisms are employed to rotate the drills and taps. On each multiple-spindle head there is a driving dog which is engaged by a bracket on the chuck, as seen in Fig. 3, so as to revolve the drilling or tapping head in synchronism with the work. As the drilling or tapping head revolves on its own axis, planetary gearing within the head causes the drills or taps to revolve on their axes at

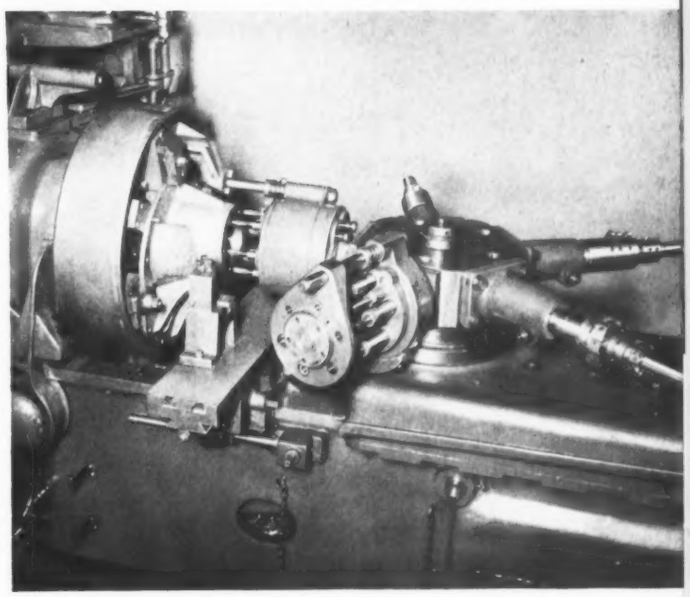


Fig. 3. Potter & Johnston Automatic with Drilling and Tapping Heads Held on Turret and Actuated from Headstock

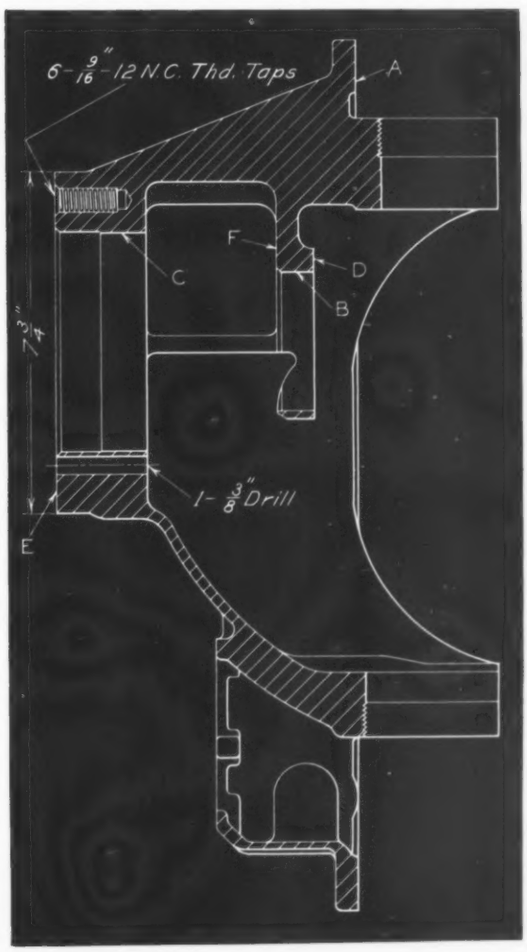


Fig. 4. Diagram of the Differential Carrier Machined by the Potter & Johnston Automatic Illustrated in Fig. 3

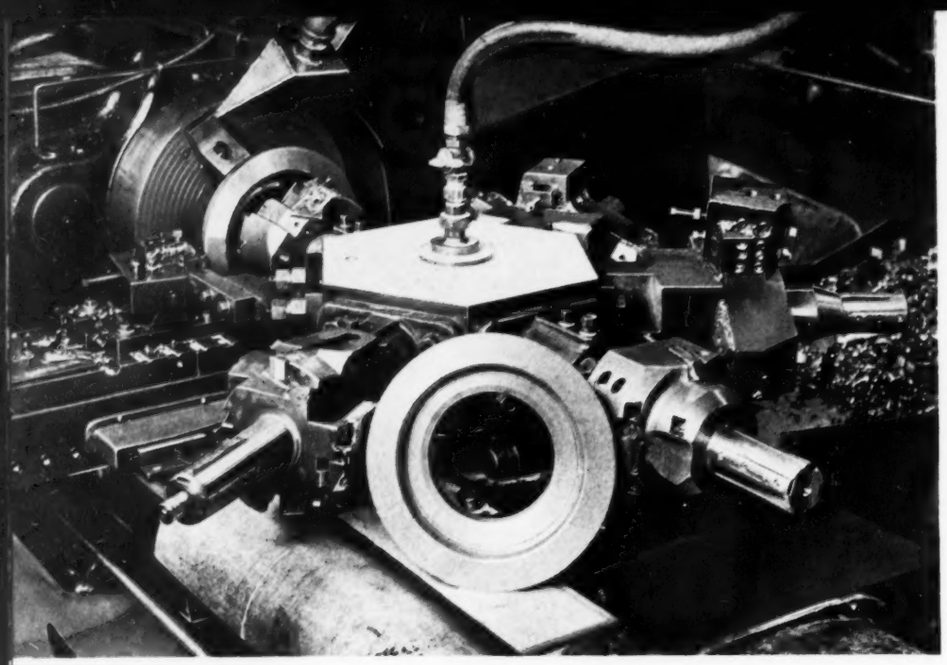


Fig. 5. A Foster Fastermatic Machines Drive-gear Forgings on the Face Angle, Back Angle, and Bore

the proper speed for drilling or tapping. The drills run at a speed of 336 revolutions per minute, and the taps at 86 revolutions per minute. At the end of the threading operation, the taps are automatically reversed to back them out of the holes.

Forgings of S A E 4620 steel for spiral bevel gears are rough-machined on the front side and on surface *H*, Fig. 6, by a Fastermatic equipped as illustrated in Fig. 5. The rough forging has an outside diameter of approximately 12 5/8 inches, and from 1/16 to 1/8 inch of stock is removed from all surfaces in this operation. Tools on the first face of the turret rough-bore surface *A* and hole *B*, Fig. 6, bevel corner *C*, rough-bore surface *D*, and face seat *E*. At the same time, a tool on the front cross-slide is fed across surface *H* by means of a bar attached to the turret, as seen in Fig. 5. The tool-block operates in ways machined to correspond with the desired angle of surface *H*. When the turret recedes at the end of this step in the operation, the tool-holder is returned to its normal position on the cross-slide by spring action.

Tools on the second face of the turret then rough-face surface *F*, semi finish-bore surface *D*, and semi finish-face surface *E*. Tools on the third turret face next finish-face surface *F*, bevel the outer corner of this surface, and chamfer the inner corner. Tools on the fourth turret face finish-bore hole *B* within 6.350 and 6.355 inches, finish-bore surface *D*, finish-face surface *E*, and round the corner be-

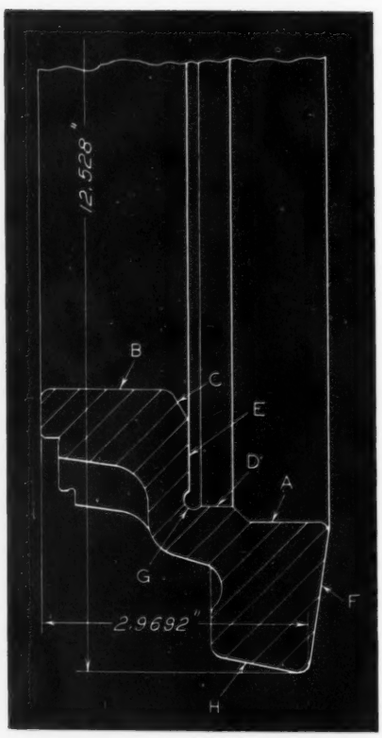


Fig. 6. (Left) Drawing which Indicates the Various Surfaces of the Spiral-bevel Drive-gear Blanks Turned and Faced by the Machine Shown in Fig. 5

Fig. 7. (Right) Cross-sectional Drawing of the Differential Case Finished all over on Machines of the Type Illustrated in Fig. 8

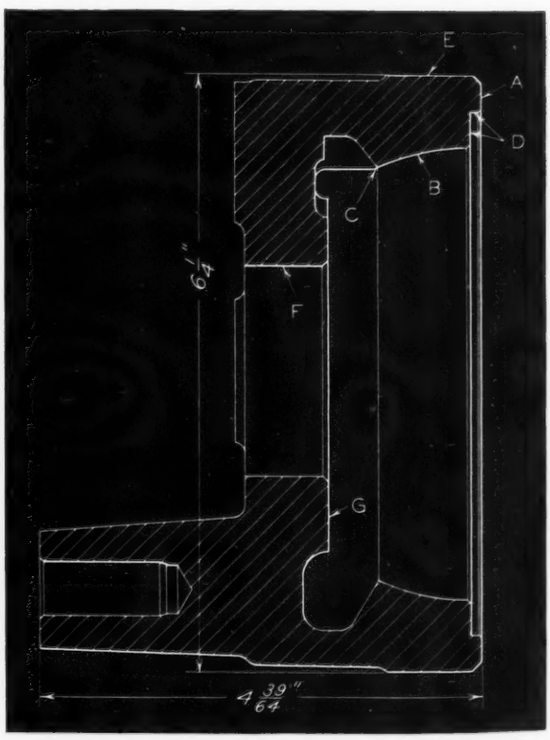


Fig. 8. Machining Differential Cases on a Potter & Johnston Automatic Chucking and Turning Machine

tween bore *B* and the taper *C*. Finally, tools on the fifth turret face form under-cut *G* and take a second finishing cut on seat *E*.

Tungsten-carbide tools are employed for rounding the various corners, for cutting groove *G* and for finish-facing surfaces *E* and *F*, all other tools being made from No. 2400 Stellite. The average production is between six and seven forgings an hour. Cutting speeds range from 105 to 256 feet per minute. The entire machine is hydraulically operated, including the chuck.

Malleable-iron differential cases, 6 1/4 inches outside diameter, are machined all over in two operations on Potter & Johnston 5D automatic chucking and turning machines. In the first operation, performed on the machine illustrated in Fig. 8, a tool on the front cross-slide rough-faces end *A*, Fig. 7, while tools on the first turret face rough-bore the spherical surface *B*, bore the inner surface *C* of the spherical surface, rough-bore and face dowel seat *D*, rough-turn periphery *E*, chamfer the front corner of surface *E*, and bore hole *F*.

Tools on the second face of the turret next rough-form seat *G*, finish-bore hole *F*, semi-finish dowel surfaces *D*, and take several chamfering cuts. Tools on the third turret face semi-finish the spherical surface *B*, finish-face seat *G*, and finish the dowel surfaces *D*. Tools on the fourth turret face then finish-ream hole *F* and under-cut the corner between the two dowel surfaces *D*. At the same time, a tool on the rear cross-slide finish-faces end *A*. The spherical surface *B* is later precision-bored on a Heald Bore-Matic.

Tungsten-carbide tools are used in the operation illustrated for semi-finishing the spherical surface and for under-cutting the corner between surfaces *D*, while Stellite No. 2400 tools are used for turning periphery *E*. All other cutters are of high-speed steel. The production is slightly over 13 pieces hourly.

A Gisholt Simplimatic is shown in Fig. 9 being used for facing the four pedestals on large malleable-iron differential carriers and for facing the irregular shaped flange. Two tools on the front tool-block rough-face the flange and pedestals. At the same time, two tools on the rear block finish-face these surfaces. The chuck is air-operated. The average production is between seven and eight differential carriers an hour, the operator of this machine also tending to two other machines.

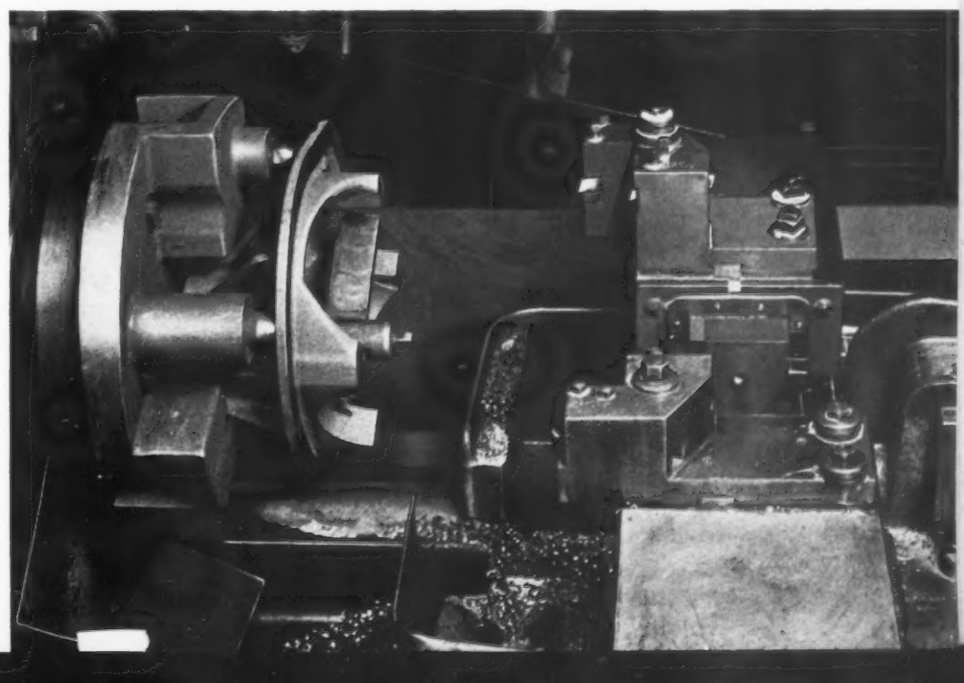
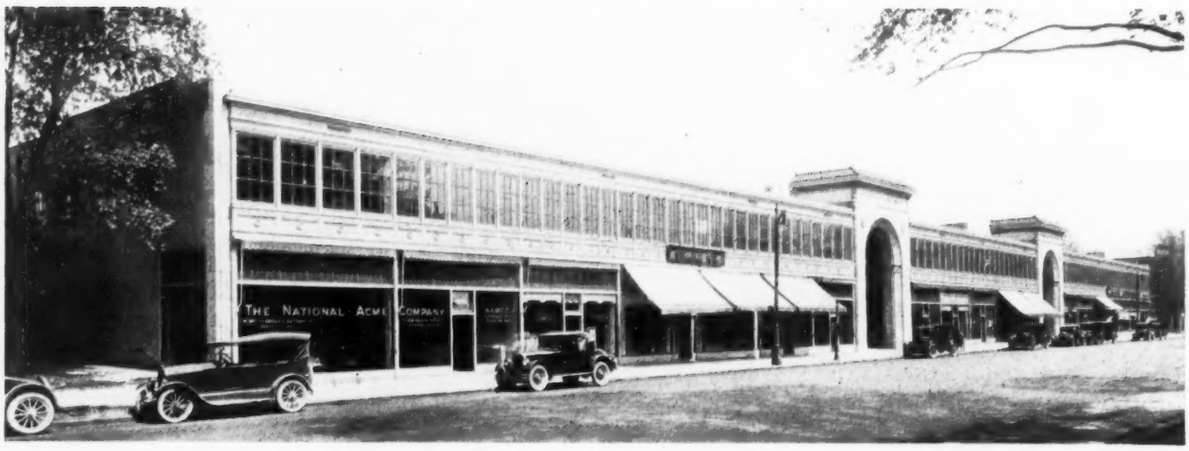


Fig. 9. Large Malleable-iron Differential Carriers are Faced on the Pedestals and around the Irregular Flange in This Gisholt Simplimatic



Progress Exhibition of the American Society of Tool Engineers

CONVENTION HALL, DETROIT, MARCH 14 to 18

THE exposition sponsored by the American Society of Tool Engineers, which is to be held this month in Convention Hall, Detroit, Mich., opens its doors to the public Tuesday, March 14, and closes at 6 P.M., Saturday, March 18. Tuesday and Thursday the show will be open until 10 P.M.; Wednesday and Friday it will close at 6 P.M.

Over 170 manufacturers will have their products on exhibition. The exhibits will include practically all kinds of tools and accessories, and many types of machines required in the machine shop industries. The latest developments in cutting tools, grinding wheels, precision tools and instruments, and auxiliaries and accessories of every conceivable type, will be represented.

In conjunction with the exposition, the American Society of Tool Engineers will hold its annual meeting. The general opening of this convention will be Tuesday morning, March 14, with registration at Convention Hall, where the technical sessions, as well as the exhibition, will be held. There will be two technical sessions. The subject of one of these will be a symposium on "Surface Finish," held Tuesday evening. At this session, grinding, boring, honing, and superfinishing will be dealt with by men especially qualified to deal with each subject. Methods of measuring surface finish and standards of surface finish will also be covered.

A second symposium, entitled "New Developments and Their Effect on the Tool Engineer," is scheduled for Thursday evening, at which papers will be presented dealing with recent progress in fields especially close to the work of the tool engineer. The annual dinner of the Society is scheduled for Friday evening, March 17.

Monday evening, March 13, there will be a special preview dinner, to which leading industrialists, educators, legislators, editors, etc., have been invited. At this dinner the Fact Finding Committee of the American Society of Tool Engineers, under the chairmanship of Professor John M. Younger, of the Ohio State University, will present its first report on "The Relationship of the Machine to Employment and Standard of Living."

This committee is endeavoring to present definite facts bearing upon this much debated question. It has already accumulated a mass of specific data, a digest of which will form part of its first report to the Society.

Engineering News Flashes

The World Over

Factory Building Uses Glass Admitting Light but Excluding Sun's Heat

One of the many interesting features in the construction of a new factory building erected by the General Electric Co., is the use of a special glass in the windows which admits light but excludes the heat of the sun's rays. The windows are of double-glazed construction, and the walls are of brick with hollow tile. This construction will provide insulating air space equivalent to a wall 16 inches thick. There will also be upper windows of hollow glass blocks for a height of 5 feet, continuous for the length of the entire building. The result of this method of lighting the shop will be diffused daylight without the admission of heat.

The new building has been made necessary by the increasing orders received by the company for large marine reduction gears. The new shop is an addition to the present gear-cutting shop. It is built completely with a welded-steel frame. It is 92 feet wide by 180 feet long, and has a clear height of 42 feet, and an over-all height of 63 feet. It will be used for the manufacture of large reduction gears up to 16 1/2 feet in diameter.

Non-Tarnishing Silver Objects Exhibited in England

A group of Cambridge (England) metallurgists recently demonstrated before the British Association silver objects treated by a process that prevents tarnishing. The process consists essentially of covering the surface of the silver with wear-resistant, invisible films of oxide of aluminum or beryllium. The discoverers of the process emphasize that its practical application may not be immediate, as methods employed in the laboratory may not be practicable in the mass production of silverware. Nevertheless, the fact that a protective film can be formed in this manner will prove of considerable interest to industry.

Pennsylvania Railroad Builds Giant Locomotives

The Pennsylvania Railroad, at its Altoona shops, is building ten new 100 miles an hour locomotives for passenger service between New York, Philadelphia, Washington, and Harrisburg. The electrical equipment for these locomotives was built by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Six twin motors, each of 770 H.P., twin-mounted on a single drive-shaft, provide the power; running at 100 miles an hour, these locomotives will develop 4620 H.P., but they have a capacity for developing up to 8000 H.P. for brief periods. All the electrical equipment has recently been shipped to the Altoona shops, where it will be installed on the locomotive chassis built by the Pennsylvania organization.

An 8,000,000 Cubic-Foot Capacity Gas-Holder

What is believed to be the world's largest gas-holder has recently been constructed at Sheffield, England, by Newton Chambers & Co., Ltd., for the Sheffield Gas Co. This gas-holder has a capacity of 8,000,000 cubic feet. The foundation upon which it is erected carries a weight of 65,000 tons.

A Motor Designed for Educational Institutions

A practical laboratory unit for demonstrating the fundamental principles involved in the operation of alternating-current motors has been developed by the Westinghouse Electric & Mfg. Co. This motor is a standard squirrel-cage type, with a special circular terminal board. Inlaid under the top surface of this board is a representation of the forty-eight slots in the primary of the motor, together with numbered lines to show the actual location of the coils in the slots.

The ends of these forty-eight stator coils are connected on the rear of the board to studs. This makes it possible to interconnect the coils in any desired manner by the use of leads or jumpers on the face of the board. In this way, the motor can be connected for two, four, six, eight, or ten poles, or for either two- or three-phase power supply. Single-phase operation can be secured by connecting for two-phase and using a capacitor (static condenser) in one phase.

This type of motor should be of considerable value to engineering students, as it will enable them to calculate resistance, reactance, and leakage constants, and to check the calculated performance against that obtained in the laboratory.

EDITORIAL COMMENT

A leading executive in the automobile industry recently defined the tool engineer as a man who makes the dream of the product designing engineer a practical achievement in iron and steel. He amplified his remarks by saying that no matter how ingenious and efficient a design was on paper, it had practical value only if it could be manufactured at a cost low enough to make possible a profitable volume of sales.

To solve that cost problem is largely the job of the tool engineer. He must devise the methods that will produce high quality at reasonable cost. He must select or design the machines required to obtain the desired results. He must devise the tooling equipment for these machines; and often it is on his advice that the small tools and accessories are selected.

The Tool Engineer Makes the Designer's Dream Come True

He is a man who can afford to make but few mistakes, because the mistakes of the tool engineer prove extremely costly, especially in the mass production industries. Upon him rests the grave responsibility for the success or failure of the manufacturing processes; he is answerable both for the quality and the cost of the product.

It is especially in the automotive industry that the tool engineer has come to occupy a position commensurate with his great responsibility. For this reason, this number of MACHINERY, which coincides with the exposition staged by the American Society of Tool Engineers in Detroit, gives marked attention to the work of the tool engineer in the automotive industry. Honor to him to whom honor is due.

The effect of burdensome and excessive taxation of industry on employment and on the welfare of labor was so well brought out in an article "The Full Dinner Pail and Where It Comes From," by Thomas Nixon Carver in *Nation's Business*, that a few extracts from this article will be of interest to everyone engaged in the mechanical industries.

"The more burdens we heap on our overtaxed industries, the fewer they can employ. The fewer they employ, the more they will have to be taxed to support the unemployed. If the worker is guided by his enlightened self-interest, rather than by his inflamed fighting temper, he will see that his well-being depends on such an expansion of industry as will put more goods within the reach of more people.

"If productive industry continues to be ground between the upper and nether millstones of predatory politicians and racketeering labor leaders, who try to get what they want by making others afraid, it cannot expand. If it cannot expand, it cannot employ more workers. If it cannot employ more workers, the Government will have to support increasing numbers on make-work projects or the dole.

The Heavier the Tax on Industry is, the Fewer are the Jobs

"If the Government continues to lay heavier tax burdens on industry—especially if it gives less protection from violence in return for the taxes which it collects—it will continue to repress industry. This will make it necessary to support still more people with still higher taxes.

"'Would you let the people starve?' is the excuse of the politician. He must know that American working men do not starve when they are employed. There are two sources from which the workers' livelihood may come. One is productive industry, where the worker produces his own purchasing power. The other is taxation, under which his purchasing power comes out of the pockets of the taxpayer.

Productive Industry is the Worker's Only Source of Livelihood

"It is not a choice between letting people starve and not letting them starve. It is a choice between giving them jobs and giving them doles. Doing useless work and getting paid for it is a dole, since the wages must be raised by taxation and do not come out of the wealth created by those who receive the wages.

"Anyone who accepts the proposition that industry is more likely to expand and employment to increase under the encouragement of a friendly—rather than under the attacks of an unfriendly—government, will know who the friends of labor are. He will realize that you cannot measure a man's friendship for labor by his hostility to industry.

"One industrialist who makes two jobs exist where one existed before is worth more to American labor than all the agitators combined. The government that lends encouragement to industrialists of that kind is the only government that deserves to be called friendly to labor."

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Feeding Mechanisms for Small Plates

By JOSEPH WAITKUS

The two mechanisms here described were designed to feed small square plates of medium thickness at a continuous and uniform rate into a special processing machine. The plates to be fed were made of a fairly dense material, but they could be easily dented or marked by rough handling.

The mechanism shown in Fig. 1 is of simple, compact construction. It has a bedplate *A* to which the adjustable guide bars *B* and *C* are fastened. Two side plates *E* secured to bedplate *A* form a chamber for stacking plates *W* that are to be fed along the bedplate between the guide bars *B*. Two movable feeding bars *F* are fitted into bedplate *A* and are fastened together by feed-plate *G* and screws *H*. A bearing block *J* connects bars *F* with the oscillating crank *K* through stud *L*.

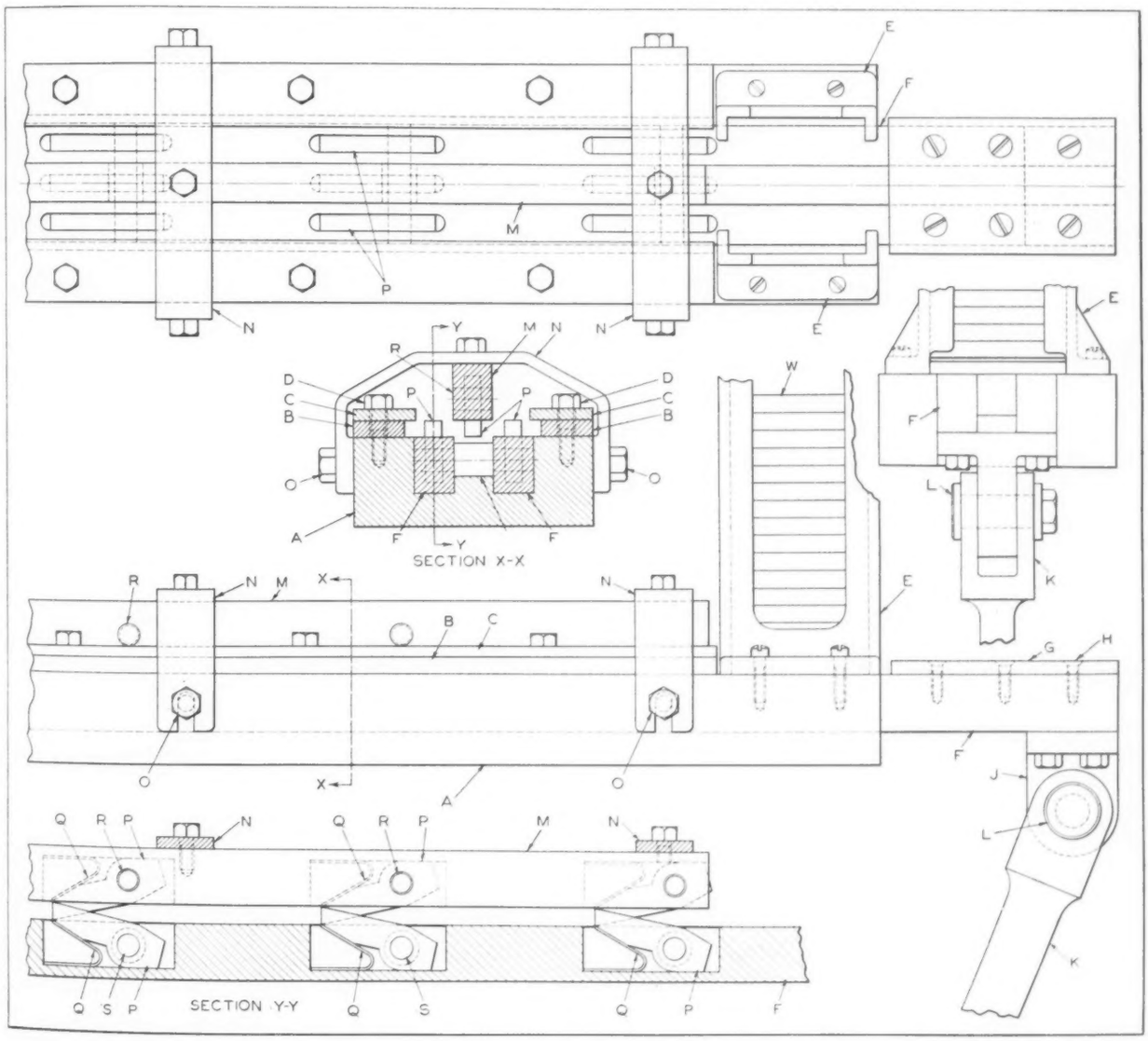


Fig. 1. Mechanism by Means of which Fingers P in Bars F, Reciprocated by Oscillating Crank K, Feed Plates W along Bed A between Guide Bars B

Stationary bar *M* is fastened to supports *N* which, in turn, are fastened to the bedplate by screws *O*. Supports *N* are adjustable for height. Movable bars *F* and stationary bar *M* are each provided with a series of fingers *P* which can be readily depressed by compressing springs *Q*. Pin *R* is pressed into place in stationary bar *M* and finger *P* is mounted on it. The fingers on movable bars *F* are mounted on shafts *S* which extend between the bars and serve as spacers.

The operation of this feeding mechanism is best understood by referring to Fig. 2, which shows the movable bar in three positions. In Position 1, fingers *P* on movable bar *F* have advanced a certain amount in the feeding direction. The fingers of stationary bar *M* are being depressed to permit the plates to pass down the feeding line. In Position 2, the fingers *P* have reached the end of their stroke in the feeding line. The positions of fingers *P* in the stationary bar *M* should be noted at this point. They are in place behind the plates, and being stationary, serve to keep the plates from sliding back or moving from their place in the reverse direction.

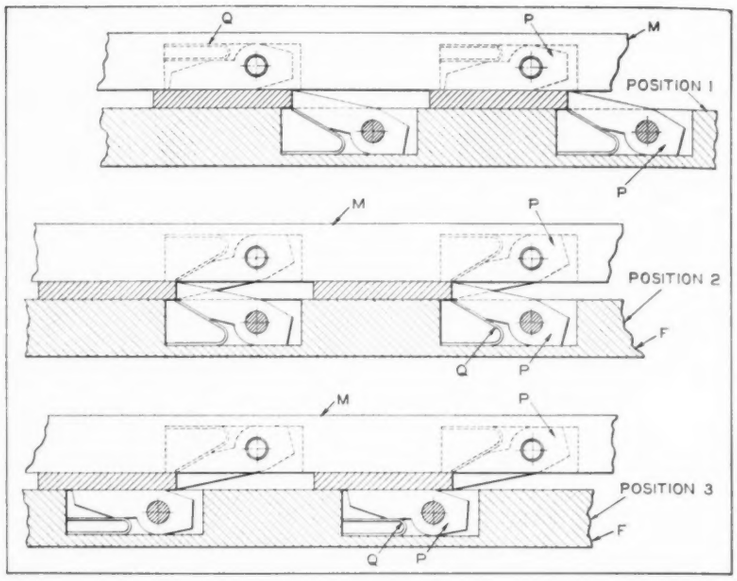


Fig. 2. Diagrams Showing Three Successive Positions of Feeding Fingers

In Position 3, we have a condition that is the reverse of that shown in Position 1. Movable bar *F*, having completed the forward movement of the plates, is returning to Position 2 at the next plate in order to repeat the stroke movement. On the

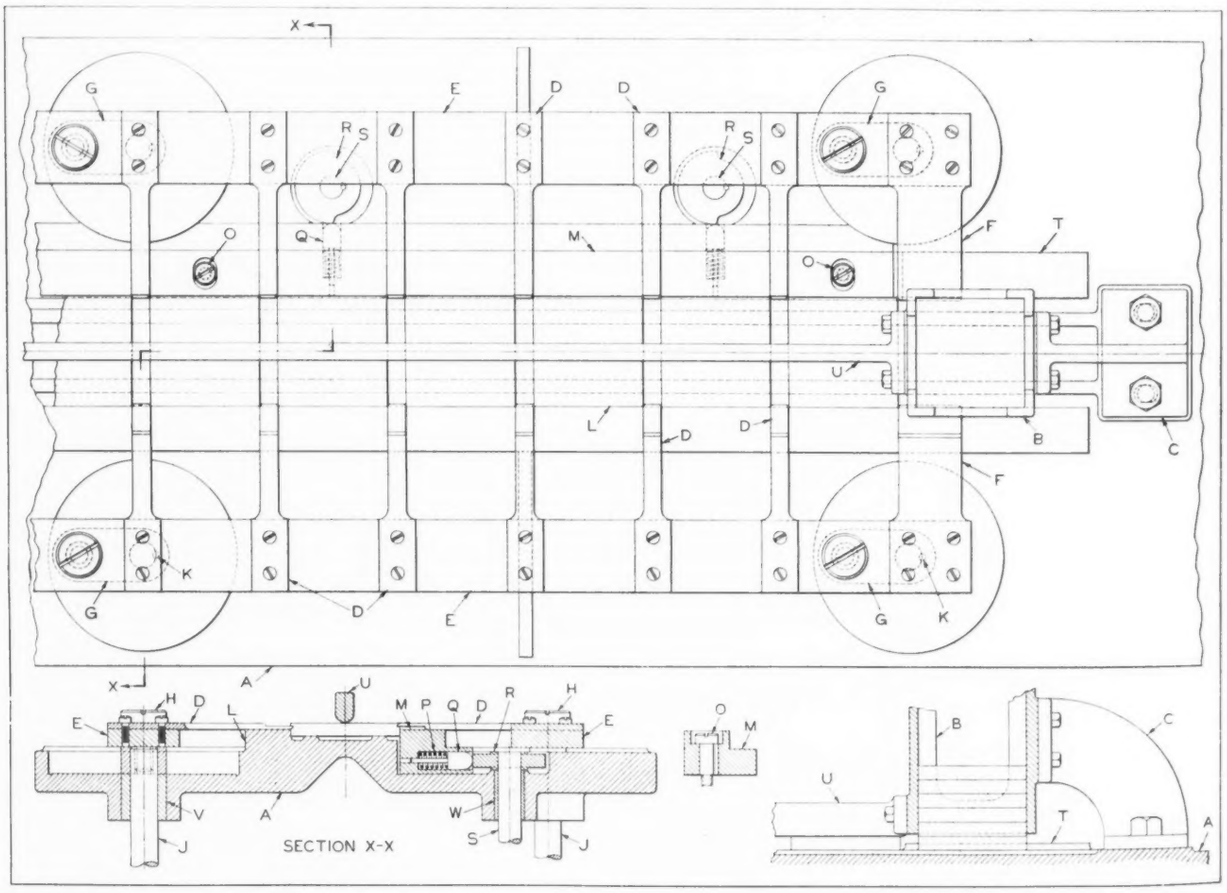


Fig. 3. Plate-feeding Mechanism by Means of which Fingers D and F on Rails E Feed Plates from Stack-holder B

return movement, fingers *P* of movable bar *F* are depressed in order to permit them to pass under the plates, while fingers *P* of stationary bar *M* hold the plates in place. Feeding plate *G*, Fig. 1, serves to slide one plate from the stack at each stroke and place it in position for the first fingers on movable bars *F*.

The second feeding mechanism, shown in Fig. 3, operates on an entirely different principle; and although it may appear complicated at first, it is in reality quite simple in operation. The mechanism is supported on baseplate *A* to which stack-holder *B* is attached by bracket *C*. The plate-actuating mechanism consists of a series of fingers *D* fastened to bars *E*.

On the plate stack, the wider fingers *F* are provided for a reason to be explained later. The two bars *E* are fastened to cranks *G* by studs *H*. Cranks *G*, in turn, are fastened to shaft *J* by pin *K*. The rotation of cranks *G* in unison imparts a firm rotary motion to bars *E*, which carry fingers *D* and *F* through a similar motion. The plates are guided on one side by shoulder *L* machined on the baseplate, and on the other side by movable bar *M*.

A better understanding of the action of this mechanism will be obtained by referring to Fig. 4. It will be noted that in Position 1, fingers *D* have just entered the space between two successive plates. In Position 2, crank *G* has passed through an angle of 90 degrees, and fingers *D* are now located between the plates. The fingers are so shaped at the ends that they can overlap each other. This overlapping is necessary to insure satisfactory operation in the case of the material being fed. The necessity for overlapping the fingers depends entirely on the width of the plate between guides *L* and *M*. The greater the width, as compared with the length, the less the fingers will overlap.

The full travel of the plate for each complete stroke is equal to the length of the plate plus the width of one finger. In Position 3, the crank has rotated another 90 degrees and the fingers are passing away from the plate. It should be noted that the plate has been displaced another distance equal to the radius of the crank circle, and has thereby completed the required displacement for the stroke. In Position 4, fingers *D* are drawn away completely from the plates, and crank *G*, continuing its rotation, finally carries the fingers back to the original or starting point shown in Position 1.

While feeding the plates during the 180-degree rotation of crank *G* illustrated in Positions 1 to 3, the plates are under the control of fingers *D*. In the interval illustrated by Position 4, the plates are free and under no control of the mechanism. In order to prevent displacement of the plates due to vibration or other causes, a locking device is provided in the feeding line which serves to hold the plates in their respective positions until they are again under the control of fingers *D*. The locking device consists of the movable guide bar *M*, Fig. 3, which is free to move at right angles to the feeding line and is guided by studs *O* fastened to bedplate *A* and fitted to slots in guide bar *M*.

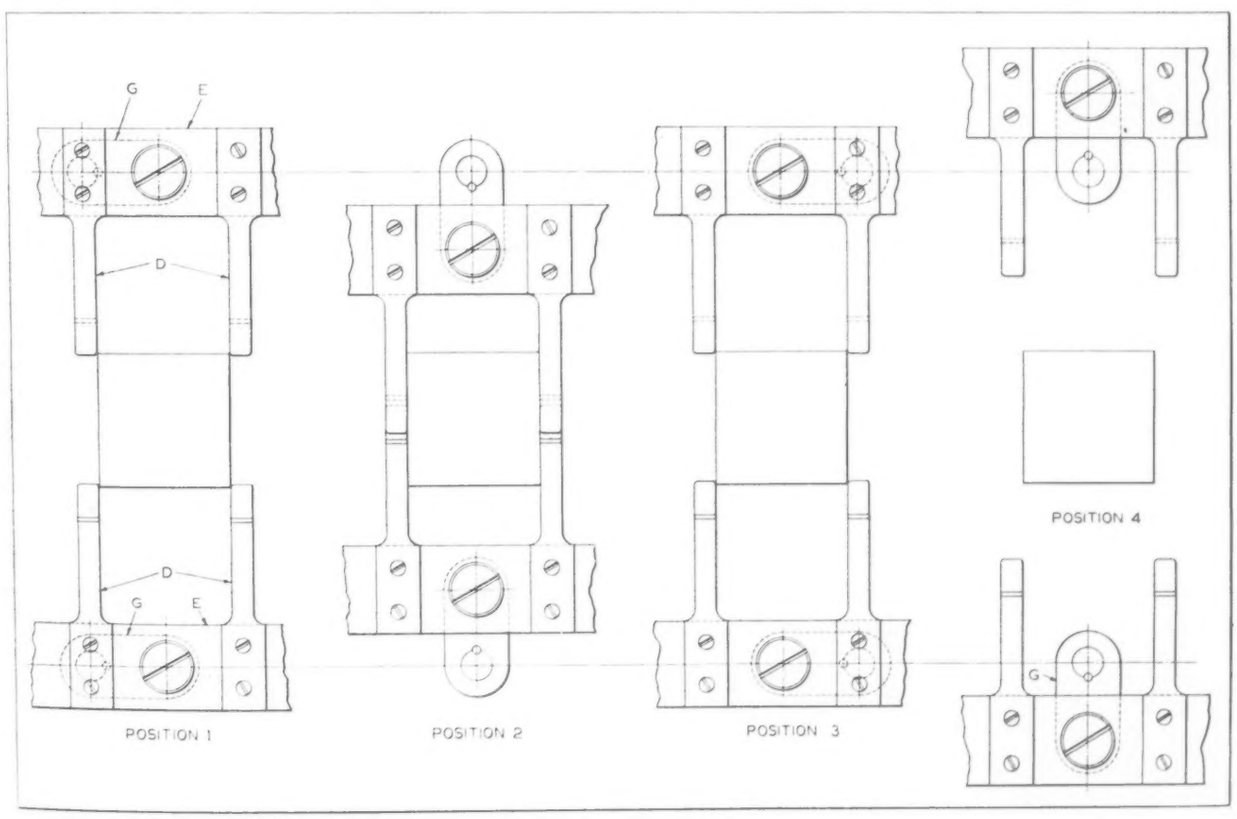


Fig. 4. Diagrams Showing Successive Positions of Feeding Fingers of the Mechanism Shown in Fig. 3

Guide bar *M* is provided with a spring-loaded feeler consisting of spring *P* and cam feeler *Q*. Cam *R* is pinned to shaft *S*, and is so located that it does not interfere with the free movement of finger-bar *E*. The rotation of the cam is synchronized with that of crank *G*, so that during the interval when the crank is rotating into Position 4, the cam is depressing cam feeler *Q* against the tension of spring *P*, which forces guide bar *M* against the plates, thus holding them in place. The slot in guide bar *M* is cut so that the bar cannot move away from the feeding line, but must maintain a certain distance between guide bars *L* and *M* which is just slightly more than the full width of a plate. This arrangement permits the plates to move down the line.

The large fingers *F* at the plate stack-holder *B* are provided for the purpose of keeping the stack of plates from tilting into a jamming position, which would be the case if the succeeding plates were not kept in a level position. By using the wide fingers, the plate stack is well supported until the fingers leave the stack. When the fingers are removed together, the plate stack drops directly into a position between guides *L* and *M*, both of which are part of the bedplate. Bar *U* keeps the plates from rising vertically from the feeding line. Suitable bushings *V* and *W* are provided for shafts *J* and *S*, respectively.

Each of the mechanisms described has its advantages. From the standpoint of cost, the mechanism shown in Fig. 1 has a slight advantage; from the standpoint of smooth operation, the advantage is with the mechanism shown in Fig. 3. The latter mechanism is less likely to injure the plates. The feeding movement per stroke in the case of the mechanism shown in Fig. 3, is limited to a definite amount determined by the dimensions of the product, whereas in the mechanism illustrated in Fig. 1, the displacement or feeding movement is unlimited, and can be arranged to meet any requirement.

In regard to the rate of feeding, the mechanism shown in Fig. 3 has been found slightly better than the one illustrated in Fig. 1. The rotary motion of cranks *G* provides a smooth means of advancing the plates in the feeding line, whereas the impact of the feeding fingers of the mechanism shown in Fig. 1 limits the feeding rate to some extent.

* * *

A Noteworthy Safety Achievement

The best safety achievement in its history was recorded during 1938 by the A C Spark Plug Division of the General Motors Corporation. Only seven lost-time accidents occurred among more than 4000 employes in the plants of this division during the entire year. During seven months of the year, there were no lost-time accidents.

Broaching Increases Production

The flexible coupling part shown in Fig. 1 was formerly produced at the rate of nine to ten an hour. To increase production to from fifty to sixty an hour, the three jaws were finished by broaching, the coupling parts being held in the fixture shown in Fig. 2.

To load the fixture, it is swung back, and the part *A* is set into the locating bushing over the mandrel *B*. At the end of the first stroke of the broach *E*, a cam *C* permits the locating bushing and part *A* to be pulled back. This, in turn, permits indexing during the return stroke of the broach, the index-pin being shown at *D*. After indexing, the hand-operated cam *C* is reset, locking the locating bushing and part *A* in the broaching position.

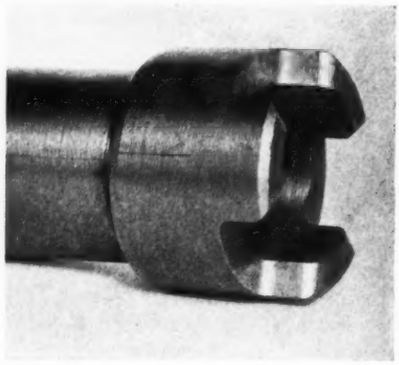


Fig. 1. Flexible Coupling Part Broached as Shown in Fig. 2

The broach, made by the Colonial Broach Co., Detroit, Mich., may be classified as a keyway slotting broach of special contour, producing proper radii at the corners in addition to finishing the jaw faces. The same principle has also been applied successfully to the broaching of clutch jaws.

* * *

In New York state, 2482, or nearly one-half of the 5107 cities, towns, and villages, depend solely on automobiles and buses for transportation.

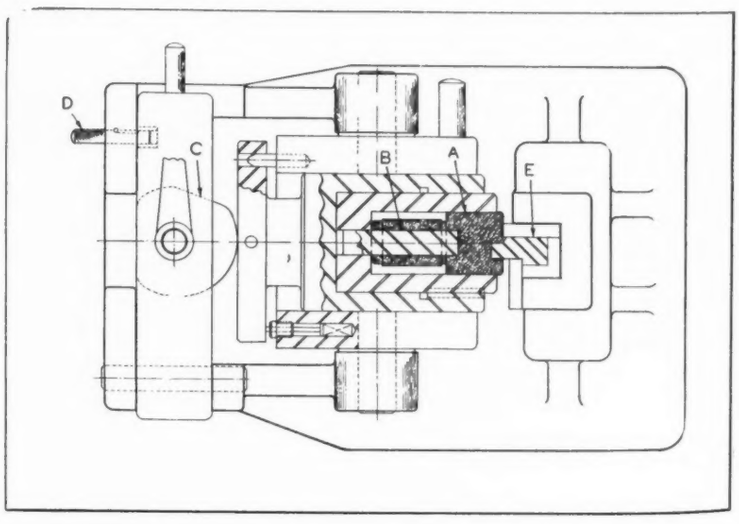


Fig. 2. Fixture Used in Broaching a Flexible Coupling Part

Nicholson File Company Celebrates Seventy-Fifth Anniversary

THE Nicholson File Co., Providence, R. I., celebrates its seventy-fifth anniversary in 1939, having been founded in 1864 by William T. Nicholson. Of equal significance to industry is the fact that in the same year Mr. Nicholson introduced a successful method of cutting quality files by machine, so that this anniversary has a double significance in the history of the Nicholson File Co., as well as in American industry.

The founder's pioneer work in quality production of files was so successful that, according to Paul C. Nicholson, vice-president of the Nicholson File Co., fourteen years after the founding of the company it supplied an annual volume double that of all the file imports into the United States.

Paul C. Nicholson, Vice-president of the Nicholson File Co.

Gradually the company expanded its activities, until today it operates four plants at Providence, R. I., Philadelphia, Pa., Anderson, Ind., and Port Hope, Ont. Much of the equipment used in these plants has been built by the company itself for its own use in the manufacture of the many types and brands of files for which it is so well known.

* * *

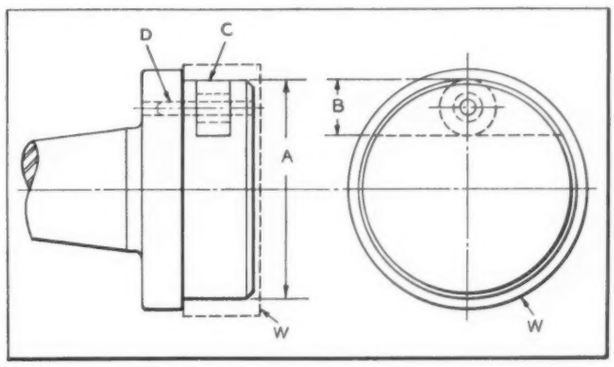
According to information furnished by the Automobile Manufacturers Association, the automobile industry is estimated to have spent $345,000,000 in 1937 for new buildings, new machines, and new tooling equipment, as well as for other facilities required to maintain manufacturing efficiency.

Quick-Loading Arbor

By J. A. BRASSARD

A quick-loading arbor for holding thin-walled rings that must be finished all over is shown in the illustration. The ring or work *W* is bored and finished on one face while held in chuck jaws before it is mounted on the arbor shown for turning the outside and facing one end.

The small end of the arbor is turned to a taper to suit the lathe spindle, and the end of the arbor at *A* is turned 0.0005 to 0.001 inch smaller than the minimum bore of the work. Slot *B* is made 0.500 inch deep, with limits of plus 0.002 inch and minus 0.000 inch and with the width to suit roller *C*, which is 0.498 inch in diameter with limits of ± 0.001 inch. This roller has a 1/4-inch hole through it for pin *D*, which is 1/8 inch in diameter. The work *W* is pushed on the arbor into the position shown. A slight twist of the arbor in a clockwise direction serves to lock it in place. The work is released from the locked position by simply turning it counter-clockwise on the arbor.



Quick-loading Arbor for Holding Thin-walled Rings

* * *

The railway express service in the United States celebrates its one-hundredth anniversary this year. Its foundation was laid on March 4, 1839, by William F. Harnden, who was the nation's first expressman. He began this service by carrying packages between Boston and New York in a carpet bag. Four times a week he made the arduous journey by train, stage coach, and steamboat. Later, he established the first express company in the country.

Machining Malleable-Iron Differential Cases and Carriers

By ANDREW W. PISHTA

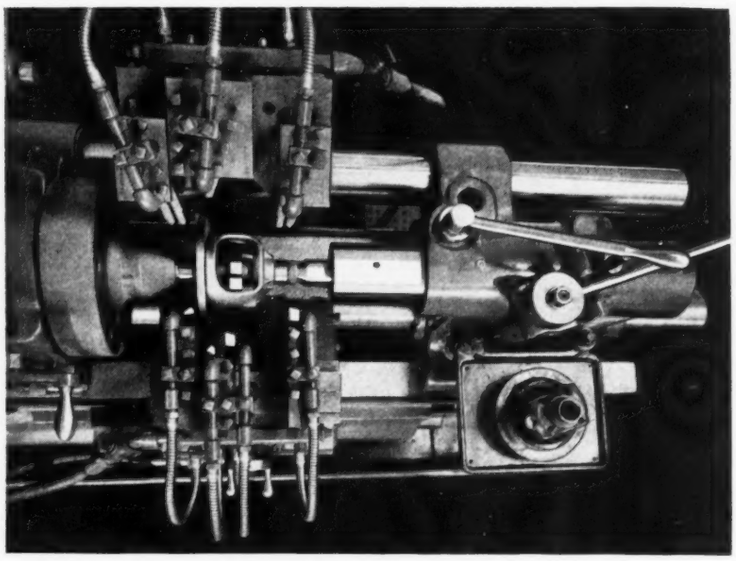


Fig. 1. Tooling Arrangement for Finish-turning the Outside of Differential Cases on a Fay Automatic Lathe

THE machining of one-piece malleable-iron automobile differential cases involves some interesting tooling engineering. In the first operation on these cases, which is performed on a 20-inch lathe, they are held in a three-jaw wrenchless chuck, gripping on the outside of the flange. Studs mounted on the face of the chuck and bearing against the face of the flange locate the work in the chuck. Toolheads carrying a core-drill, a counterbore, and a turning tool are mounted in the tailstock of the machine. These tools bore, center-drill, spot-face the ends of the hubs, and rough-turn the outside diameters of the hubs.

While these cuts are being taken, tools mounted on the carriage rough-turn the outside diameter of the case, and a tool on the back arm rough-faces the flange. The method of centering the ends of the casting insures uniform depth of centers, which is important, since the centers are the locating points for subsequent operations on other machines. A production of from 50 to 60 cases an hour is obtained, depending on the size of the case. A case 7 inches in length, with a flange diameter of 7 1/2 inches, is machined at the rate of 50 an hour, which provides for a 20 per cent allowance for lost time.

The second operation—the finish-turning of the outside—is performed in a Fay automatic lathe, with the cases held on stub centers and driven by an internal-drive fixture which bears against the sides of the large cored holes in the side of the case. Tools mounted on the carriage turn the bearing diameters and the ring-gear pilot diameter. While these cuts are being taken, tools on the back arm face all shoulders and form the required chamfers.

Fig. 1 shows a view of the tooling arrangement as seen from above. The production for the second operation also ranges from 50 to 60 cases an hour. The tools used for both operations, are J-metal tipped, with the exception of the core-drill and counterbore used in the first operation, which are made from high-speed steel.

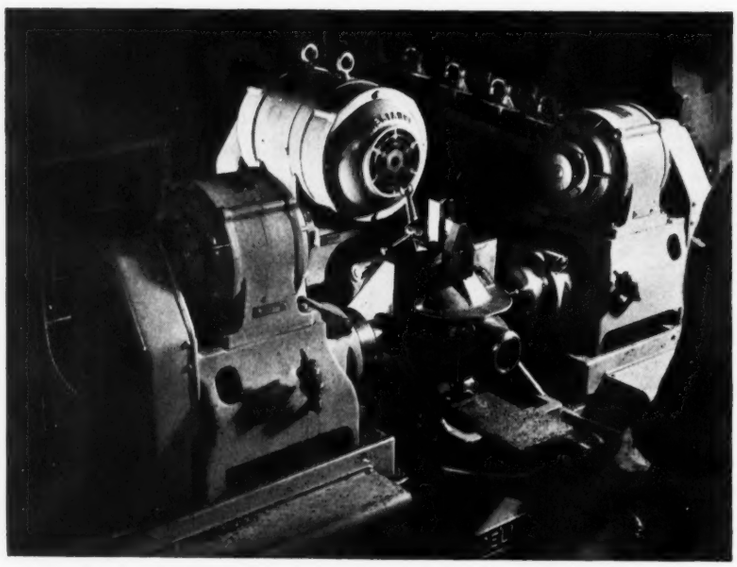


Fig. 2. Boring Differential Carriers on an Ex-Cell-O Three-way Boring Machine

Machining Differential Carriers

Malleable-iron differential carriers can be machined on several different types of machines. In a recent installation, a Potter & Johnston automatic chucking and turning machine is used for this work.

A back-facing attachment allows the inner hub to be faced. A multiple-spindle drilling head not only drills the six 31/64-inch holes and the 3/8-inch dowel-

pin hole, but also counterbores and chamfers. The tapping head, with reversible spindles, threads the six holes. Thus, work formerly performed in five separate set-ups is now accomplished in one operation.

The machine used is fully automatic, except for chucking the work. One operator handles two or three machines on this class of work. The flange is faced and the bolt holes in the flange are drilled in a previous operation. When the differential carrier reaches the Potter & Johnston machine, it is placed in a fixture, located by pins in two of the bolt holes, and clamped with three clamps bearing on the flange.

The tools in the first turret face rough-bore the carrier (two bores, 3.151 and 5.001 inches in diameter), rough-face the 7 3/4-inch diameter, and rough-face an inner surface of the inside bearing support, using a back facer which is passed through the spindle. At the second turret station, the two holes are finish-bored, the end is finish-faced, and the required chamfers are machined. At the third turret position, the holes are reamed, and the tools in the drill head drill and chamfer the six 31/64-inch holes and the dowel-pin hole. Finally, the tapping head comes into action, tapping the six holes.

The machining time required for these operations is 5.26 minutes. Two minutes are allowed for chucking, so that the floor-to-floor time per carrier is slightly over 7 minutes, which is equivalent to a production of approximately eight pieces per hour per machine. It may be stated, however, that in another shop, using the same kind of machines, a production of 10.6 pieces per hour is obtained.

Another feature in the machining of the differential carrier is the use of an Ex-Cell-O three-way boring machine which finishes the bores for the two carrier bearings and the pinion bore, as indicated in Fig. 2. By performing these three operations at one setting, accuracy is insured. The malleable-iron carrier is located from two drilled and reamed bolt-holes. Tungsten-carbide tipped tools are used. It is stated that the squareness of the carriers between the holes and face, is within 0.0002 inch in 7 inches. The production is at the rate of 60 carriers an hour.

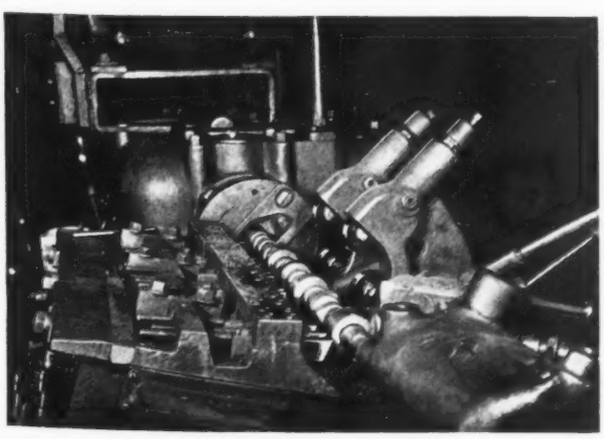
Statistics of the Machine Tool Industry

ACCORDING to the Census of Manufacturers for 1937 on the machine tool industry, details of which have recently been made available by the Bureau of the Census, there were, in that year, 291 establishments engaged in manufacturing machine tools, employing on an average 47,250 wage-earners and paying out in wages $78,300,000. Almost exactly the same amount was paid out for materials, supplies, and fuel. In addition, there were the expenses for interest, rent, depreciation, taxes, insurance, and selling. The total value of the product of the plants in the industry was $260,000,000, which includes products other than machine tools manufactured in machine tool plants. The value of the machine tools, including replacements and repair parts, totaled $216,000,000.

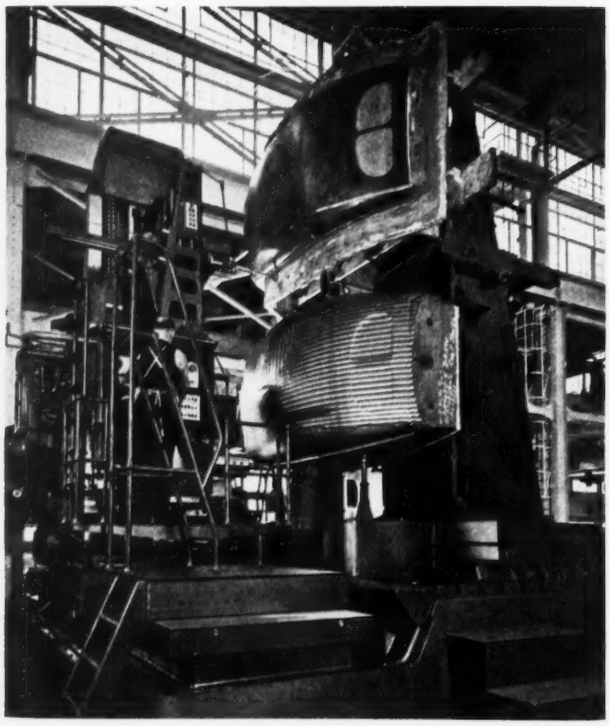
The machine tool industry, as defined by the Bureau of the Census, is "the industry primarily engaged in the manufacture of power-driven metal-cutting machines generally designated 'machine tools.'" Certain types of machines designed for working metal, especially sheet-metal working machines, welding machines, wire-drawing machines, and wire-working machines, do not come under the classification of machine tools.

* * *

One in five of the 43,000 patents granted by the United States in 1938 had an application in the automotive industry, a total of 8268 patents being related to motor vehicles in some manner.



Machining the Bearings of a Cast Alloy-iron Camshaft with Stellite J-Metal at a Surface Speed of 71 Feet per Minute, a Feed of 0.015 Inch per Revolution, and a Depth of Cut of 1/16 Inch



Ford Opens Up New

TWO major units in the $34,000,000 plant expansion program carried out during 1938 by the Ford Motor Co. were virtually completed early in January of this year. Of these projects, the new air-conditioned tool and die shop concentrates under one roof almost all of the tool and die work at the Rouge plant. The structure is probably the largest building in the world designed solely for this class of work. It is 1225 feet long by 300 feet wide, and contains 1311 machines, of which 508 are new. The shop is equipped for doing practically any tool or die job, regardless of size. At present there are about 1900 men in the shop.

This tool and die shop has been laid out in three main divisions, one of which is devoted to body die and small die construction, another to the production of tools, jigs, fixtures, and gages, and the third to machine construction and repairs.

The shop was laid out along the principles of straight-line production. There is a high central bay running the complete length of the building, with a lower bay on each side. A central monitor, with monitors at right angles to it, provide a maximum amount of daylight. The monitors, side walls, and main walls are constructed largely of glass, and as the building is set well away from other plant buildings, sunlight is unobstructed.

The other major unit just completed is the press shop, which has a total of 1,500,000 square feet of floor space, 850,000 square feet being on the main manufacturing floor and the remainder on an

Fig. 1. (Upper Left) Huge Automatic Tool-room Machine Producing a Die for an Automobile Roof Panel

Fig. 2. (Center) Chipping and Grinding Intricate Details on a Large Die Member with Portable Tools

Fig. 3. (Left) A Bevel Gear Cutting Machine of Latest Design Installed in the New Tool and Die Shop

Tool and Press Shops

above-ground basement floor. The building, which is L-shaped, forms an integral part of another building that covers 64 acres and is three-fourths of a mile long by 1000 feet wide.

The press shop consists of only two stories, although its general appearance is that of a four-story building. There are 2100 presses in the recent addition, of which 300 are new. This new equipment has increased the plant's capacity by 2000 automobile bodies a day.

One of the features of this shop is the provision for easily rearranging the presses when product changes make it necessary. The presses can be picked up by one of three 90-ton overhead cranes, moved to a new location, and lowered into place on a supporting structure located below an opening in the floor. The floor itself is made up of 1-inch steel plates surfaced with cedar blocks. The plates are screwed to steel floor beams.

In laying out the building, fender presses were located near the steel storage, which is fed directly from the rolling mill. Small drill presses and welders are arranged nearby for drilling and welding operations. The front grille stamping departments are near the fender presses. Body and side panels and steel tops are made on still another line. Around these presses are smaller machines for succeeding operations, and still smaller presses for making small parts from the scrap of the larger machines. Conveyors are a conspicuous feature, the shipping conveyor alone being four miles long.

Fig. 4. (Upper Right) Looking Down One of the Rows of Huge Presses in the New Ford Press Shop

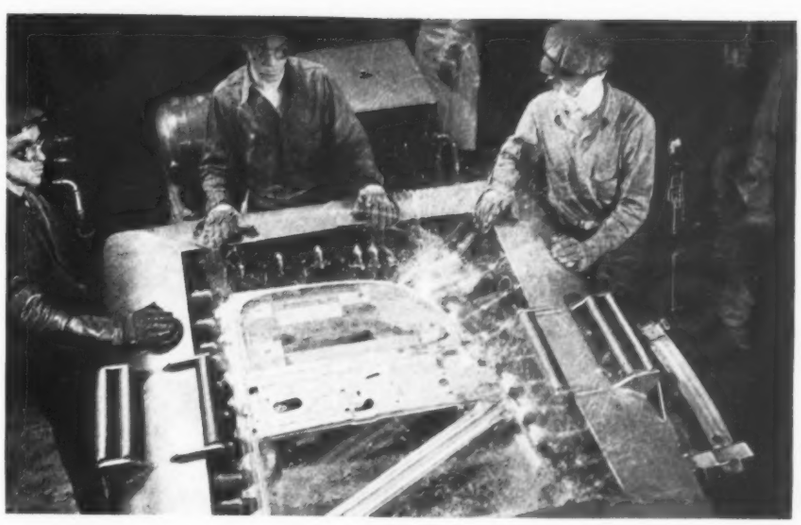
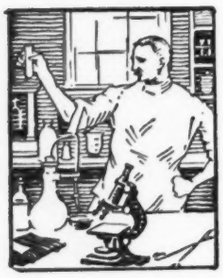


Fig. 5. (Center) A High-production Machine Simultaneously Produces a Number of Welds on Door Frames

Fig. 6. (Right) Another of the Welding Machines that have Helped to Increase Production of Automobile Bodies

MATERIALS OF INDUSTRY



THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

New Type Insulation Greatly Improves Magnet Wire

A new type of magnet wire known as "Formex" has been developed by the General Electric Co., Schenectady, N. Y. This wire is insulated with a synthetic resin which is tougher and more flexible than the conventional enamel coatings and takes up a great deal less space. Hence, it gives the designer new opportunities to reduce the size of many products of which this wire is an integral part.

The electrical properties of this wire are as good as those of ordinary enameled wires, and tests have shown that it has considerably higher resistance to abrasion and to the common treating solvents. When severely twisted and then subjected to a temperature of 125 degrees C. (about 260 degrees F.) for one hour, ordinary enameled wire cracks, while Formex wire is not affected. It is stated that the improved qualities of the new type of insulation have been demonstrated in the actual manufacture of many electrical products. 201

Nickel-Molybdenum Cast Iron for Valve Bodies

In selecting the material to be used in the valve bodies of the pressure regulators made by the Reliance Regulator Co., Alhambra, Calif., it was necessary to determine on a material that would have both the required strength and considerable resistance to corrosion and abrasion. These requirements led to the adoption of nickel-chromium-molybdenum cast iron for the valve bodies, an important feature of this material being its machinability, in addition to its strength and resistance to corrosion and abrasion.

The cast iron used is a 50 per cent steel mixture, the analysis of a typical heat being as follows: Total carbon, 3.16 per cent; silicon, 2.35 per cent; manganese, 0.90 per cent; nickel, 1.20 per cent; chromium, 0.40 per cent; and molybdenum, 0.50 per cent. A test bar 1.20 inches in diameter as cast, and 0.80 inch in diameter when machined, had a tensile strength of 53,260 pounds. A test bar 0.75 inch in diameter as cast, and 0.505 inch when machined, had a tensile strength of 66,700 pounds per square inch.

The completed valve bodies were tested by hydrostatic pressure. The fine close-grained structure makes the metal leakproof at pressures far higher than any likely to be encountered in service. As to actual strength, it took a hydrostatic pressure of 3600 pounds per square inch to rupture a 3-inch valve body that was tested to destruction. 202

Dies Made from Strenes Metal Give Unusual Service

A material known as "Strenes" metal, made by the Advance Foundry Co., Dayton, Ohio, is said to give unusually satisfactory results for drawing and forming dies, punches, forming pads, and draw- or pressure-rings. Recently, the Dayton Tool & Engineering Co., Dayton, Ohio, made some tractor hood top dies for a leading farm tractor manufacturer from this metal. The total weight of the first-draw die was 5900 pounds, and that of the second-draw die, 11,000 pounds. In both of these dies there is about 5000 pounds of Strenes metal.

It is stated that dies made from this metal cost less than those made from conventional die materials for three reasons: First, the cost of the Strenes stock—a chromium-nickel-molybdenum alloy—is less than that of conventional die materials. Second, the Strenes alloy can be cast to shape, eliminating a large amount of machine work and stock removal. Third, by using a continuous ring and cast-shape construction on die, punch, pad, and draw-rings, the machining of the parts all over, as is necessary with conventional sectional type dies, is avoided.

The savings effected by the use of the two dies referred to amounted to approximately 25 per cent. In fact, 200 hours of machining time was eliminated in the case of the two drawing dies used for the first and second draw. Up to 500 hours of machining time has been saved by the use of this metal for a single large die.

The estimated output of the dies mentioned is 200 tractor hood tops a day. It is expected that

To obtain additional information about materials described on this page, see lower part of page 512.

they will last for several years. In the plant of a refrigerator manufacturer, dies from this metal are said to have produced more than 1,350,000 refrigerator top stampings from 0.050 inch material. The dies have been stoned and polished only twice a year. 203

Advantage of Glass as an Industrial Material

A great deal of publicity has been given to the use of plastic materials in various industrial fields. The manufacturers of glass have recently been very active in pointing out the unexcelled qualities of glass for many industrial purposes. Glass can be molded, pressed, or blown into an almost limitless variety of shapes and sizes. It has extremely high dielectric properties; it is impervious to almost all acids and other corrosive substances, and is unaffected by light; its coefficient of expansion is small; and it can be ground or drilled. In addition, it meets a most important requirement—low cost.

To make available information relating to the uses of glass in industry, the Anchor Hocking Glass Corporation, Lancaster, Ohio, has organized a new industrial division to cooperate with manufacturers who are seeking information on the best materials for certain purposes. The application of glass for such uses as insulation, meter covers, and bowls or other containers that form integral parts of other equipment, is especially stressed. 204

High-Strength Nickel Iron Used in Recent Machine Tools

The extent to which high-strength alloy cast irons are being used in machine tool construction is exemplified by the uses made of this metal in some recently built machine tools. In an exceptionally large boring mill built by the Simmons Machine Tool Corporation, Albany, N. Y., the gears and all of the smaller cast parts in which high strength and wear resistance, as well as a dense machinable structure were required, are made of nickel cast iron conforming to "Class 60" of the American Society for Testing Materials specifications. This class of cast iron must have a minimum tensile strength of 60,000 pounds per square inch. Actual tests of the cupola iron showed a strength of 66,000 pounds per square inch.

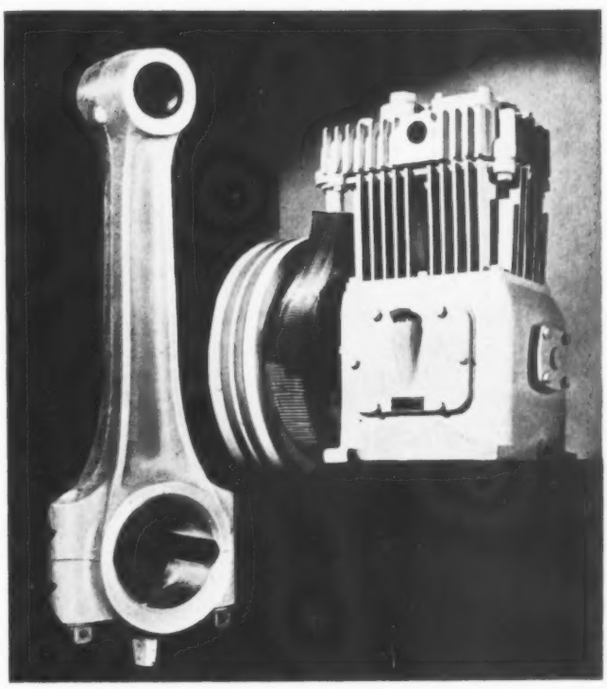
In a large hydraulic planer built by the Rockford Machine Tool Co., Rockford, Ill., which was recently installed at the International Nickel Co.'s plant at Huntington, W. Va., for machining bars of nickel, Monel and Inconel, there are 33 tons of alloy iron castings. The iron used in the columns has a tensile strength of over 43,000 pounds per square inch, while that used in the bed exceeds 50,000 pounds per square inch. The iron used in the table and cross-rail has a tensile strength of 39,500 and 37,000 pounds per square inch, respectively. The Brinell hardness of the column iron is 228, that of the bed and table, 241, and that of the cross-rail, 207.

In addition to these major parts, the table gibs, feed cylinder, rail-head, and side-head parts are made from nickel-iron castings, while the highly stressed steel parts of the machine, such as the principal gears, pinions, shafting, nuts, studs, and pins, are made from heat-treated nickel-chromium steel S A E 3140. The pumps, spindles, pump valves, and reversing valves, furnished by the Oilgear Co. of Milwaukee, are of nickel-molybdenum steel...205

Aluminum Connecting-Rods Now Used on Air Compressors

The accompanying illustration shows a connecting-rod recently developed by the Bohn Aluminum and Brass Corporation for a new type of Quincy air compressor. This compressor has been designed with a view to obtaining exceptionally high overall efficiency. The saving of weight in the reciprocating parts was found essential to obtain this efficiency, as well as for smooth operation. A saving in weight of 40 per cent, as compared with steel, was accomplished by the use of a connecting-rod made of Bohnalite, an aluminum alloy.

With the advances in aluminum technique and the development of new and stronger alloys, the possibilities of aluminum connecting-rods are being studied by engineers in the automotive field also. 206



A Quincy Air Compressor with Aluminum-alloy Connecting-rod

To obtain additional information about materials described on this page, see lower part of page 512.

NEW TRADE LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts and Materials. To Obtain Copies, Check on Form at Bottom of Page 511 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the March Number of MACHINERY

Electrical Equipment

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. Booklet B-2164, describing how to select and use synchronous motors. Pamphlet B-2131, on motor starters. Catalogue Section 47-225, on feeder-voltage boosters; 47-230, on feeder-voltage booster-regulators; and 11-200, on deion non-reversing line-starters. 1

Railway Alloy Steel

JOSEPH T. RYERSON & SON, INC., 16th and Rockwell Sts., Chicago, Ill. Bulletin on an alloy steel for railway use, especially developed to meet the demand for an oil-hardening steel which, when heat-treated, will develop a high degree of hardness and deep penetration and will have minimum distortion and freedom from cracking. 2

Drop-Hammers

CHAMBERSBURG ENGINEERING CO., Chambersburg, Pa. Bulletin 255A, illustrating and describing Chambersburg Model E steam drop-hammers. Bulletin 275A, illustrating and describing the "Cecostamp"—a high-production impact stamping machine for stamping light-weight, high-strength, sheet-metal parts. 3

Small Tools

UNION TWIST DRILL CO., Athol, Mass. Catalogue N, covering the complete line of tools made by the company, including milling cutters, gear-cutters, twist drills, hobs, and reamers. A section is also included on machine tools. Complete specifications, including prices, are given. 4

Tools

CHICAGO WHEEL & MFG. CO., 1101 W. Monroe St., Chicago, Ill. Catalogue covering the "Handee" line of hand-controlled tools for grinding, drilling, sawing, engraving, routing, etc., applicable for tool-room work and a wide range of industrial uses, as well as home use. 5

Industrial Lighting

R L M STANDARDS INSTITUTE, INC., 20 N. Wacker Drive, Chicago, Ill. Publication entitled "The Meaning of the R L M Label on Industrial Lighting Equipment," explaining the purpose of the label and its value in specifications and purchase of industrial lighting equipment. 6

Collets for Automatics

NATIONAL ACME CO., 170 E. 131st St., Cleveland, Ohio. Folder illustrating and describing QC (quick-change) master collets, which take stock sizes up to the maximum spindle capacities of all Acme-Gridley multiple-spindle automatics that use draw-in collets. 7

Pneumatic and Hydraulic Cylinders

HANNA ENGINEERING WORKS, 1765 Elston Ave., Chicago, Ill. Catalogue 228, entitled "Hanna Cylinders to Fit the Job," illustrating, describing, and giving complete specifications of Hanna cushioned and non-cushioned cylinders. 8

Superfinishing Process

CHRYSLER CORPORATION, Detroit, Mich. Booklet descriptive of the "Superfinishing" process and the results obtained with this process, as compared with other types of machined surface finish, such as turning, grinding, honing, and lapping. 9

Power-Press Dies

STRIPPIT CORPORATION, 1559 Niagara St., Buffalo, N. Y. Catalogue 5, covering perforating and notching dies and stripper units. Also folder entitled "Wales Dies," covering individual self-contained sub-press type dies and stripping units. 10

Broaches

AMERICAN BROACH & MACHINE CO., Ann Arbor, Mich. Catalogue 139, covering the broaches made by this company for any class of broaching operation, either external or internal. Various broaching machine set-ups are also illustrated. 11

Quick-Action Clamps

AGERSTRAND CORPORATION, Muskegon, Mich. Circular descriptive of the Viking quick-action clamp for cabinet gluing and all-around assembly work. The circular also shows oven type and liquid bath furnaces for heat-treating. 12

Portable Blueprinter

ELECTRONIC PRODUCTS MFG. CORPORATION, 208 W. Washington St., Ann Arbor, Mich. Circular descriptive of the "Elpro" portable blueprinter, a low-cost, light-weight unit that operates on an ordinary power circuit. 13

Foot Control Switches

LEEDS ELECTRIC & MFG. CO., 1840 Broad St., Hartford, Conn. Circular illustrating and describing foot-control switches for unit-powered machines and tools. This device makes for safety, convenience, and saving of time. 14

Counting Machines

DURANT MFG. CO., 2210 Twelfth St., Detroit, Mich. Catalogue Sections 7 and 8, descriptive of Productimeter stroke counters and revolution counters, respectively, for all kinds of industrial counting problems. 15

Machine Tools and Machine Shop Accessories

ATLAS PRESS CO., Kalamazoo, Mich. Catalogue 39, giving complete information on Atlas lathes, shapers, drill presses, arbor presses, and shop equipment and accessories. 16

Carburizing Baths

CASE-HARDENING SERVICE CO., 2281 Scranton Road, Cleveland, Ohio. Folder describing CHS carburizing

baths supplied in three types for different case depths. 17

Nickel and Nickel Alloys

INTERNATIONAL NICKEL CO., 67 Wall St., New York City. Booklet entitled "Iron-Nickel Alloys for Magnetic Purposes—20 to 90 Per Cent Nickel." Also bulletin T-15 on "Engineering Properties of Nickel." 18

Heat-Indicating Equipment

LEEDS & NORTHRUP CO., 4921 Stenton Ave., Philadelphia, Pa. Catalogue N-33A(5), illustrating and describing manually operated indicators for thermo-couple temperatures. 19

Multi-Purpose Machine Tool

HACK MACHINE CO., 440 N. Oakley Blvd., Chicago, Ill. Catalogue illustrating and describing the Hack Multi-versal machine tool, in which a great many different machining operations can be performed. 20

Punching and Riveting Machines

ENGINEERING & RESEARCH CORPORATION, Washington, D. C. Catalogue illustrating and describing the Erco line of automatic punching and riveting machines. 21

Drill Chucks

SCULLY-JONES & CO., 1901 S. Rockwell St., Chicago, Ill. Folder 95, describing the "Feed as You Need" chuck, by means of which considerable savings in drill costs can be obtained. 22

Precision Lathes

SOUTH BEND LATHE WORKS, 424 E. Madison St., South Bend, Ind. Catalogue 46-B, announcing the new South Bend 9-inch work-shop precision lathe, which is made in eight different types. 23

Babbitt Metal

JOSEPH T. RYERSON & SON, INC., 16th and Rockwell Sts., Chicago, Ill. Bulletin explaining the physical structure of Glyco babbitt, and giving recommended applications for the various grades. 24

Bench Grinders

DIEHL MFG. CO., Elizabethport, N. J. Circular 1932, illustrating and describing Diehl heavy-duty electric bench grinders, equipped with direct lighting fixture, and portable grinders. 25

Abrasives

ABRASIVE CO., Philadelphia, Pa. Abrasive Grain Data Sheet No. 1, containing information on Borolon, an aluminum-oxide abrasive for the polishing trade and general industrial use. 26

Milling Machines

CINCINNATI MILLING MACHINE CO., Cincinnati, Ohio. Circular illustrating, describing and giving specifications of Cincinnati Nos. 2-18 and 2-24 plain automatic milling machines. 27

Drill Jig Bushings

EX-CELL-O CORPORATION, Detroit, Mich. Catalogue listing standard drill jig bushings made by this company. Complete specifications are given, including prices. 28

Overhead Conveyors

LINK-BELT CO., 307 N. Michigan Ave., Chicago, Ill. Book 1630, containing illustrations showing a large number of applications of Link-Belt overhead conveyors. 29

Collapsible Machine Taps

MURCHEY MACHINE & TOOL CO., 951 Porter St., Detroit, Mich. Circular illustrating and describing Murchey Type M collapsible machine taps for tapping straight threads. 30

Ball and Roller Bearings

BALL & ROLLER BEARING CO., Danbury, Conn. Catalogue 15, covering ball thrust bearings, roller thrust bearings, journal roller bearings, and annular roller bearings. 31

Electric Motors

LOUIS ALLIS CO., Milwaukee, Wis. Bulletin 515, containing an unusual chart indicating the application of different types of motors for different kinds of service. 32

To Obtain Copies of New Trade Literature

listed on pages 510-512 (without charge or obligation) mark with X in the squares below, the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail to:

MACHINERY, 148 Lafayette St., New York, N. Y.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50

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Electric Motors

HARNISCHFEGER CORPORATION, 4536 W. National Ave., Milwaukee, Wis. Bulletin C-4, descriptive of heavy-duty direct-current mill motors. 33

Portable Electric Tools

VAN DORN ELECTRIC TOOL CO., Towson, Md. 1939 catalogue of portable electric tools and accessories, covering the entire Van Dorn line of 114 different tools. 34

Portable Electric Tools

BLACK & DECKER MFG. CO., Towson, Md. 1939 catalogue covering the Black & Decker line of portable electric tools and accessories, including several new products. 35

Speed Reducers

JANETTE MFG. CO., 556-558 W. Monroe St., Chicago, Ill. Bulletin 22-33, covering Janette motorless speed reducers in ratings of from 1/20 to 7 1/2 H.P. 36

Industrial Filters

CUNO ENGINEERING CORPORATION, Meriden, Conn. Catalogue entitled "80 Ways to Make More Money," covering industrial filter problems of every description. 37

Electric Motors

CENTURY ELECTRIC CO., St. Louis, Mo. Manual 12-121, containing instructions on the installation, care, and adjustment of fractional-horsepower motors. 38

Speed Reducers

ALLIS-CHALMERS MFG. CO., Milwaukee, Wis. Leaflet 2203-B, illustrating and describing self-contained gearmotor speed reducers for efficient low-speed operation. 39

Welding Equipment

PROGRESSIVE WELDER CO., 737 Piquette Ave., Detroit, Mich. Catalogue showing examples of Progressive hydraulic welding and punching equipment. 40

Taps

JOHN BATH & CO., 18 Grafton St., Worcester, Mass. Booklet entitled "Nevers," covering various tapping practices that should be avoided. 41

Hacksaws

SIMONDS SAW & STEEL CO., Fitchburg, Mass. Booklet entitled "Hacksaw-ology," containing hints on the care and use of hacksaw blades. 42

Lathes

SHELDON MACHINE CO., INC., 3261 S. Cottage Grove Ave., Chicago, Ill. Circular illustrating and describing Sheldon back-geared, screw-cutting, precision lathes. 43

Abrasive Belt Surfacers

PRODUCTION MACHINE CO., Greenfield, Mass. Circular illustrating and describing the company's new No. 608 abrasive belt surfacing machine. 44

Pyrometers

BRISTOL CO., Waterbury, Conn. Catalogue covering the company's entire line of Wide-Strip pyrometers, recorders, and controllers. 45

Electrical Equipment

SCHAEFER BROS. CO., 1059 W. 11th St., Chicago, Ill. Catalogue on control apparatus, rheostats, and resistors. 46

Lubricating Systems

BOWEN PRODUCTS CORPORATION, Auburn, N. Y. Catalogue AF-74, on Bowen hand-operated lubricating systems. 47

Tool Steel

CRUCIBLE STEEL CO. OF AMERICA, 405 Lexington Ave., New York City. Folder TS201, on Ketos oil-hardening tool steel. 48

Furnaces

AJAX ELECTROTHERMIC CORPORATION, Trenton, N. J. Folder on Ajax-Northrup melting and heating furnaces. 49

Alloy Steel for Dies

ADVANCE FOUNDRY CO., Dayton, Ohio. Folder describing Strenes metal for forming and drawing dies. 50

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 513-530 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment mark with X in the squares below, the identifying number found at the end of each description on pages 513-530—or write directly to the manufacturer, mentioning machine as described in March MACHINERY.

51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78
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To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on pages 508-509 mark with X in the squares below, the identifying number found at end of each description on pages 508-509—or write directly to the manufacturer, mentioning name of material as described in March MACHINERY.

201	202	203	204	205	206

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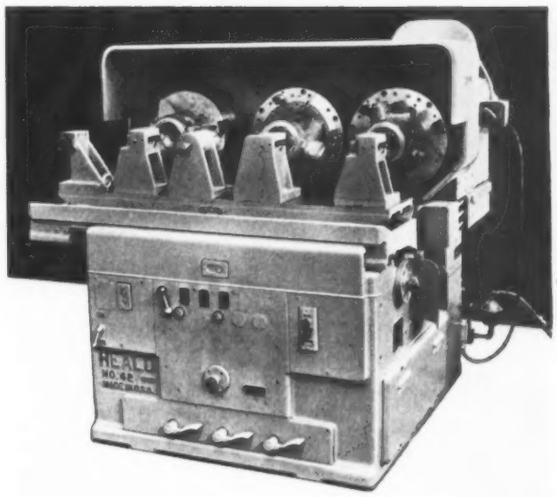
[SEE OTHER SIDE]

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts and Material-Handling Appliances Recently Placed on the Market



Heald Bore-Matic Equipped with Three Stations for Multiple Progressive Operations

Heald Precision Boring Machine Designed for Multiple Operations

A No. 42 Bore-Matic heavy-duty precision boring machine, designed for multiple operations on large heavy work, has just been brought out by the Heald Machine Co., Worcester, Mass. This machine has an extremely rigid and massive base with two sets of ways on which are mounted two tables. The front table slides on ways that are parallel with the front of the machine, while the rear table has a movement at right angles to the ways of the front table. The front table provides space for mounting either tool-blocks or stationary work fixtures. The rear table accommodates the boring heads, as well as their driving motors and jack-shafts. The boring heads on the rear table can be equipped to rotate either work fixtures or tools.

Both tables are actuated by separate hydraulic cylinders, controlled by a single throttle. Independent control of the feeds is obtained by means of individual valves, conveniently located at the front of the machine. The feeds are infinitely adjustable within the range provided. Both tables also travel at rapid traverse to and from the work and for indexing. Hydraulic pressure for both tables is obtained from a single motor-driven pump, mounted within the base at the rear of the machine.

This machine is unusually flexible, both in the character of work that can be handled and in the number of operations that can be performed in one cycle. It is adapted for the precision-finishing of many types of heavy work. Long awkward pieces or work of large diameter can be handled. Multiple operations on several different parts or progressive operations on similar parts can be performed, including boring, turning, plunge-grooving, plunge-facing, and generated facing, in the same automatically controlled cycle, with automatic indexing between successive stations.

Extra wide faces can be finished in a generated cut. The work can be either rotated in fixtures or held stationary on the table. All stations are easily accessible from the front of the machine, making the loading and adjusting of the tools very convenient. While intended primarily for precision finishing operations, where a high degree of accuracy is required, this machine has the rigidity and weight necessary for performing roughing operations.

Forward movement of the rear table provides the stroke for boring, turning, plunge-grooving and plunge-facing operations. The movement of the front table provides for generated facing operations and indexing. Both of these table traveling movements are combined to produce a cycle that can be modified to meet requirements for machining any particular part. If desired, the machine can be furnished with a locked front table for use where straight boring only is required.

The Bore-Matic shown in the illustration is arranged with three stations for multiple progressive operations on pump bodies. Both sides of these pump bodies are machined, eleven surfaces being finished in all operations, including boring, turning, grooving, counterboring, plunge-facing, and generated facing. One completely finished pump body is produced at each cycle, with the machine equipped as seen in the illustration.

The size of the machine base is 52 3/4 inches by 48 inches, and the total floor space required is 78 by 77 inches. The front table feeds range from 1 inch to 25 inches per minute. Feeds for the rear table range from 1 inch to 15 inches per minute. The maximum travel of the front table is 12 inches, and the maximum travel of the rear table, depending on the length of the particular base furnished, is either 6 or 12 inches. The weight of the machine, without the heads and fixtures, is approximately 12,300 pounds. 51

To obtain additional information about equipment described on this page, see lower part of page 512.

Jones & Lamson Thread-Grinding Machine

A universal automatic thread-grinding machine for work up to 5 inches in diameter has been brought out by the Jones & Lamson Machine Co., Springfield, Vt. The new machine will grind threads up to 12 inches long anywhere on work 24 inches in length. The machine swings work 7 inches in diameter and takes work 30 inches long between centers.

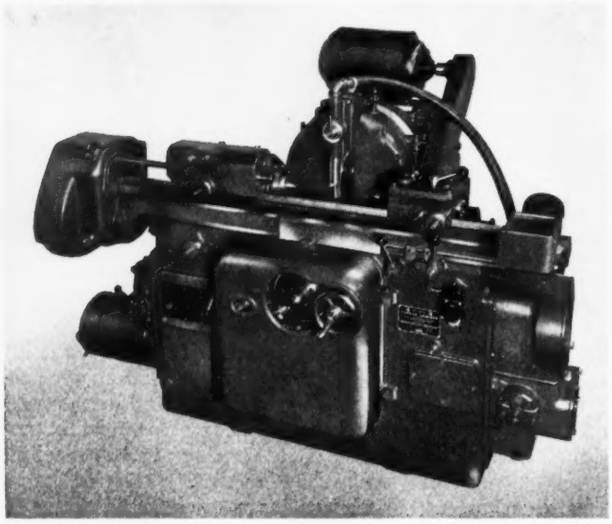
The accuracy of the thread angle is guaranteed within plus or minus 5 minutes on half the angle, and the lead to within plus or minus 0.0002 inch per inch, with a cumulative error not exceeding 0.001 inch in 12 inches. On production work, the machine will grind threads automatically to a pitch diameter tolerance of 0.0005 inch.

The grinding wheel spindle and its driving motor are mounted in a cradle to permit tilting the wheel to correspond with the helix angle of the thread. Provision is made on the work-spindle to compensate for backlash when grinding in both directions. The tailstock can be adjusted for grinding slight tapers. When tapers of more than a few thousandths inch are to be ground, they are obtained by inserting hardened and ground formers, which control the action of the wheel-slide and make it unnecessary to compensate for either the lead or the form on the grinding wheel. With suitable formers, the machine will grind combinations of tapers, straight and taper, or double taper threads.

The work drive, with push-button "start," "stop," and "jog" control, is by a motor geared to a transmission shaft furnishing power for revolving the work and for the table travel. Individual motors are provided for the coolant pump and wheel-truing device. The grinding wheel also has an individual motor driving through pulleys with V-belts.

The machine feeds the grinding wheel automatically until the correct size is reached, at which point the feed is stopped automatically. The wheel is also automatically advanced to compensate for the decrease in its size after truing. During the wheel-truing cycle, the wheel speed is automatically slowed down; when the truing is completed, the wheel returns to normal speed.

The machine will grind single, double, triple, quadruple, and sextuple threads. It has change-gears for all commercial pitches from 2 to 48 inclusive—a total of 33. It will grind right-hand threads having helix angles up to 25 degrees, and left-hand threads with angles up to 30 degrees. 52



Jones & Lamson Universal Automatic Thread-grinding Machine for Diameters up to 5 Inches

Wright Speedway Hoist

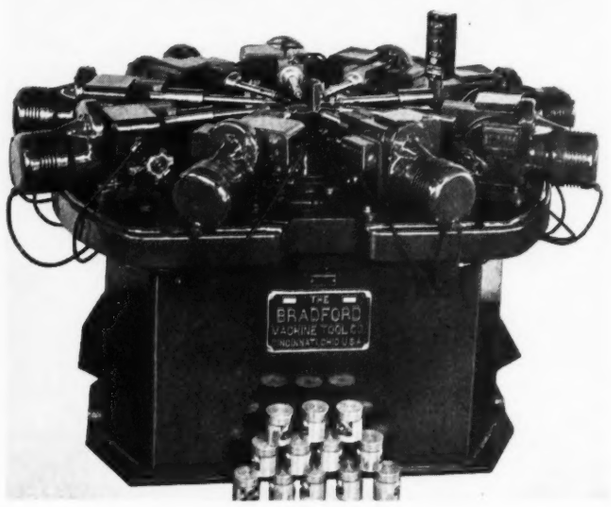
A light-weight, low-cost, wire rope electric hoist known by the trade name "Speedway" has been added to the line of hoists built by the Wright Mfg. Division of the American Chain & Cable Co., Inc., York, Pa. The hoisting capacities of the new hoists range from 250 to 750 pounds, and the hoisting speeds from 15 to 43 feet per minute. These hoists are made in three types, for lug suspension, for hook suspension, or to be mounted on a trolley. 53

Bradford Electrically Controlled Drilling Machine

A machine for drilling closely spaced small holes, such as the "smoke" holes in automotive pistons, has been brought out by the Bradford Machine Tool Co., 657 Evans St., Cincinnati, Ohio. The pistons drilled in this machine have eighteen holes, so spaced that it is not possible to drill them all at the same time. Therefore, the machine first drills nine holes, automatically indexes the piston 180 degrees, and then drills the remaining nine holes.

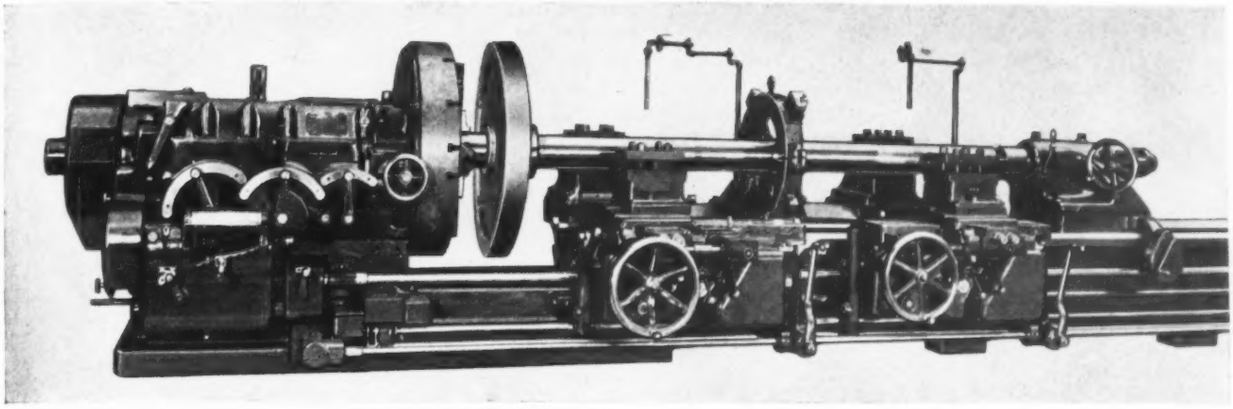
The machine has a welded steel base which also acts as a chip collector. On top of the base there is a cast-iron table with radial T-slots in which nine Bradford automatic units are fastened. The work-holding fixture is placed on an electrically operated indexing table, the control of the machine being from a push-button station. All movements are synchronized and electrically interlocked.

Each of the nine automatic units is provided with a 1/2-H.P., 3450-R.P.M., ball-bearing, fully enclosed motor. The spindle speeds are 5100 R.P.M.; the indexing time for the 180-degree movement is less than 1/2 second. The machine finishes 600 pistons an hour, which is equivalent to 10,800 drilled holes. 54



Bradford Electrically Controlled Machine for Drilling Closely Spaced Small Holes

To obtain additional information about equipment described on this page, see lower part of page 512.



Gap-bed Lathes Built in 36-, 42-, and 48-inch Sizes by the American Tool Works Co.

American Gap-Bed Lathes

For handling work with large flanges or projections extending beyond the normal swing of the lathe, the American Tool Works Co., Cincinnati, Ohio, has developed a fixed gap bed lathe which is available in 36-inch, 42-inch, and 48-inch sizes.

These lathes, which are designed for from 40- to 50-H.P. motors, are available in various bed lengths to suit the maximum length of the work to be machined. Eighteen spindle speeds are provided, twelve of which are secured through a powerful faceplate drive. The transmission of power to the head is through hardened steel gears, ground and lapped, of unusually large proportions. This design insures long life and low maintenance cost. The entire head mechanism is automatically oiled by means of a pump circulating system which forces all the oil through a filter for cleaning before use.

A filler block for the gap can be furnished to close the gap when machining work of normal diameters close to the faceplate. 55

"Erco" Automatic Punching and Riveting Machines

The Engineering & Research Corporation, Riverdale, Md., has brought out a new line of "Erco" automatic punching and riveting machines which includes a C type frame model having a throat depth of 36 inches and a beam type model with a 96-inch span.

With these machines, the rivet hole is punched through two or more layers of material after the layers are in the assembled position. The punch remains in the hole it punches, keeping the parts in accurate alignment, until the rivet is fed down on the punch, which pushes the punch out of the hole. No shifting of the material is possible, and no effort is required to locate the rivet in the hole, as the two operations are fully automatic and are performed without moving the material or the machine.

These machines are air-operated, using an air pressure of from 90 to 100 pounds per square inch. Holes up to 5/32 inch in diameter can be punched through metal sheets having a combined thickness up to 5/32 inch. For the countersunk type rivets, however, the maximum combined thickness of all layers should not exceed 75 per cent of the diameter of the rivet shank.

Fig. 1. "Erco" C Type Frame Automatic Punching and Riveting Machine

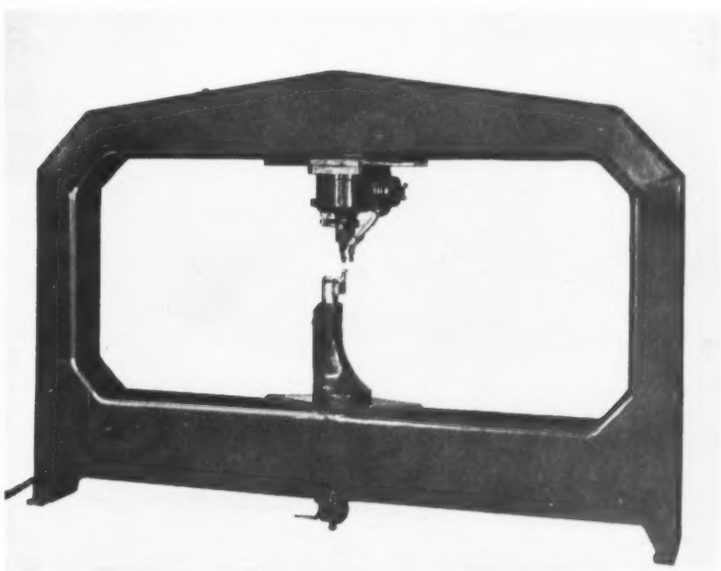


Fig. 2. "Erco" Beam Type Automatic Punching and Riveting Machine with 96-inch Span

To obtain additional information about equipment described on this page, see lower part of page 512.

Rivets up to 5/16 inch in diameter by 1/2 inch long can be handled. All types of solid and tubular rivets, including countersunk rivets, within the capacity of the machines can be handled with equal facility. The machines are so arranged that they can be used for automatically punching and riveting, punching only, or riveting only. 56

Doall Contour Sawing Machine

Continental Machine Specialties, Inc., 1301 Washington Ave., S., Minneapolis, Minn., has brought out a new Doall contour sawing machine for cutting shapes and contours in any metal or material. This machine will cut at the rate of 1 1/2 inches per minute in tool steel 1 inch thick, and at the rate of 3 1/2 square inches per minute in cast iron. Tilting the work-table makes it possible to cut angles, as well as contours, in one operation. It removes a section as a whole piece instead of reducing the metal to chips. The saw leaves a cut only 1/16 inch wide with a clean machine finish and without distorting the metal. It will saw the toughest stainless and high-carbon steels, and cuts aluminum, brass, plastics and the softer materials.

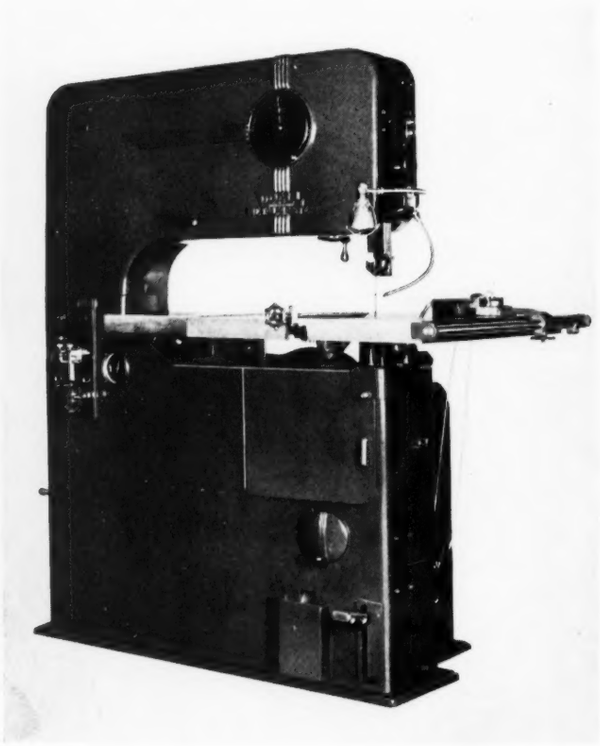
When the saws are used for internal cuts, they can be instantly welded into bands with an automatic butt-welder located in the machine. The machine has a 36-inch throat and a work height capacity of 10 inches. It is built of arc-welded steel, the housing serving as a frame for the machine. The work-table is 30 inches square and 2 1/2 inches thick and can be tilted in four directions. A 1-H.P. motor drives the machine through a variable-speed unit which provides a speed range of from 0 to 1500 surface feet per minute. A tachometer dial indicates the exact speed. A 1/4-H.P. motor drives a small grinding wheel mounted in the panel, which is used for removing the "flash" of the weld on the saw bands. The weight of the machine is approximately 1775 pounds. 57

Tomkins-Johnson Hydraulic "Rivitor"

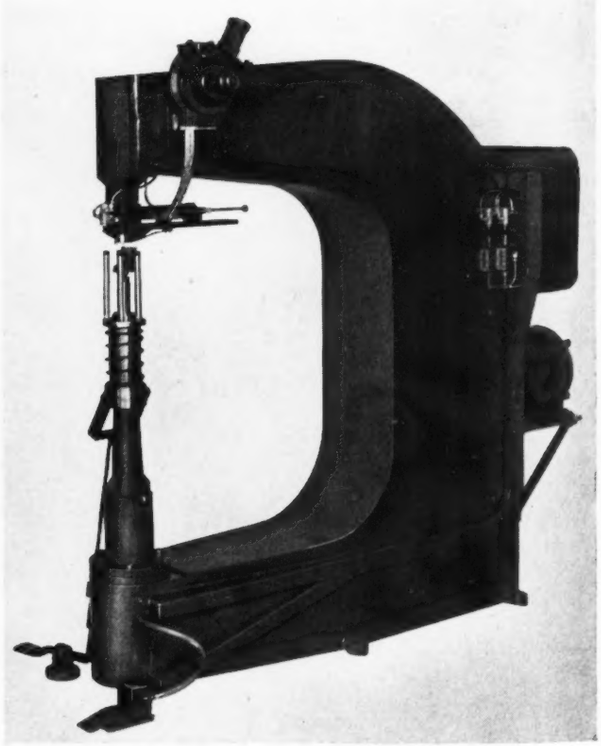
A hydraulic riveter for use in the aircraft industry has been developed recently by the Tomkins-Johnson Co., Jackson, Mich. This machine, designated the "Rivitor," is designed to automatically feed and set countersunk-head rivets. Round-head rivets can also be handed, if desired. It is particularly adapted for use in the fabrication of the fuselage and wing structures.

The machine has a capacity for setting rivets in sizes up to 3/16 inch in diameter by 1 inch long, handling rivets up to 5/8 inch long without changing the tooling. The difference in rivet lengths does not affect the riveting stroke, which ceases only when a predetermined pressure is attained. Uniform pressure is applied to each rivet, pressures up to 12,000 pounds being available for the riveting operation.

When the machine is in operation, a rivet is automatically selected and placed in position at the end of the preceding setting operation. The operator can see the rivet and does not have to locate the work over it. The work is raised and held tightly against the rivet head by operating a foot pedal. Next a valve is operated, which causes the rivet transfer arm to be returned. The operator then presses another foot-pedal, which causes the ram to come up underneath the work and set the rivet at a pressure that is always uniform. As the ram recedes, another rivet is automatically selected and brought into position by the transfer arm. 58

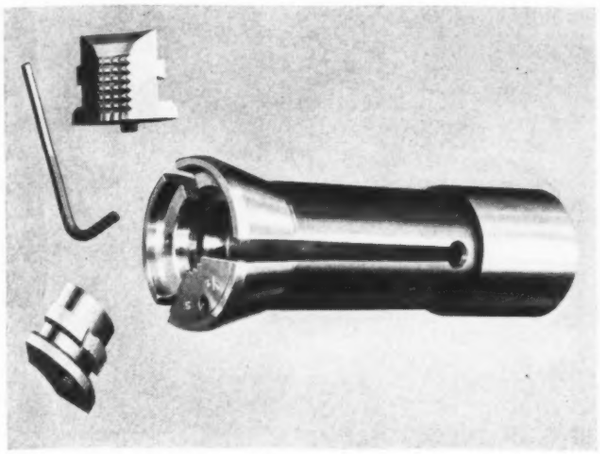


Doall Contour Sawing Machine Brought out by Continental Machine Specialties, Inc.

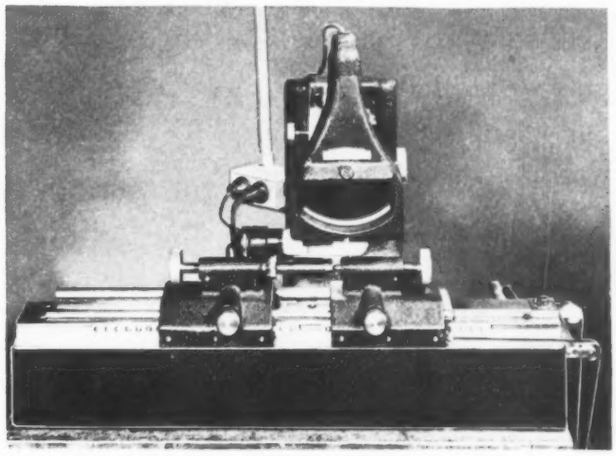


Tomkins-Johnson Hydraulic "Rivitor" Built for Use in the Aircraft Industry

To obtain additional information about equipment described on this page, see lower part of page 512.



National Acme Quick-change Master Collets



Sheffield Thread Lead Testing Machine

National Acme Master Collets

The National Acme Co., 170 E. 131st St., Cleveland, Ohio, has developed a QC (quick change) master collet with quick-change pads. These collets take stock sizes up to the maximum spindle capacities of all Acme-Gridley multiple-spindle automatics that use draw-in collets.

In the new collet, the screws that hold the pads are located in the face of the pads. The operator only has to loosen the screws, and the pads can be lifted out quickly. No removal of the collet or holding of its tube at the rear end of the machine is necessary. When the pad screw is tightened, the dovetailed shoulder on the pad tongue is drawn downward into its groove in the collet. The dovetailed design positively seats each pad. This not only resists the shock of feeding, but prevents loosening and breaking of screws and misalignment of pads when the machine is being loaded. 59

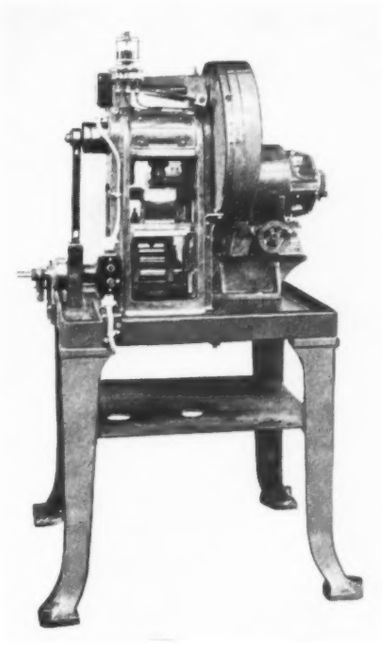
Sheffield Thread Lead Testing Machine

The Sheffield Gage Corporation, Dayton, Ohio, has brought out a new lead-testing machine in which the lead interval of a screw or worm thread is compared with a precision or master block setting. This testing machine is made in two standard models. The No. 30 model provides a simple, accurate means for inspecting threads up to 5 inches in length and 6 inches in diameter on work up to 10 inches between centers. The standard No. 40 and special models are available for testing longer screw threads.

The work-carrying centers ride on precision balls in V-grooves, insuring smooth, true travel throughout the length of the bed. After placing a part between centers, both of the centers are locked in respect to each other, so that they become, in effect, a single slide during the gaging operation. By turning the piece to be gaged, the indicator can be quickly brought to zero on the scale. The gage head is then raised out of the thread by operating a control knob, after which the precision block or blocks are removed to allow the slide to move to the right through the proper predetermined distance. Next, the gage head is lowered into the thread at this new point. The accuracy of the lead can then be read directly on the scale. 60

Waterbury-Farrel High-Speed Blanking Press

A high-speed press of 4 tons capacity, the first in a series, has been placed on the market by the Waterbury Farrel Foundry & Machine Co., Waterbury, Conn. This press, known as the No. 0 "High-Speed Blanker," is especially intended for blanking, forming, and piercing operations on a quantity production basis. It operates at speeds of from 300 to 900 R.P.M.



Waterbury-Farrel 4-ton High-speed Blanking Press

The press is equipped with a rear roll feed of standard type, adjustable for height, easily removed to gain access to the tools, and fitted with a gate-actuated roll release, so that ordinary piloted follow tools for standard die sets can be accommodated. One of the new features of the machine is the patented two-post gate guide, in which the guide-post bearings are both located above the gate or slide and below the dies. This provides an exceptionally efficient means of guiding.

The machine has no clutch, but is driven by a belt directly from the motor pulley to the flywheel, with provision for regulating the speed by a variable-speed device. It is started by a push-button, and stopped from either front or back by a handle which opens a switch and at the same time applies the brake to the inside of the flywheel flange.

The principal specifications are as follows: Standard stroke 3/4-inch, and maximum stroke 1 1/4 inches; clearance between guide posts, 6 1/4 inches; distance from center of gate to roll feed frame, 3 5/8 inches;

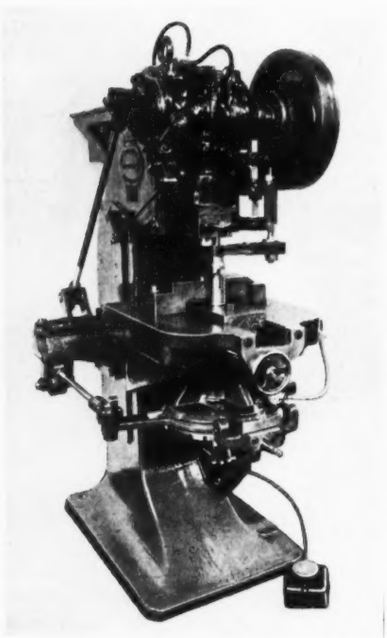
To obtain additional information about equipment described on this page, see lower part of page 512.

distance from feed line to bed of press, 2 1/2 inches; and maximum feed, 2 inches. The machine occupies a floor space of approximately 30 by 40 inches. It has a height of 64 inches, and weighs 1075 pounds.....61

V & O Improved Notching Presses and Fixtures

Several new features have been incorporated in the high-speed notching presses and fixtures built by the V & O Press Co., Inc., Hudson, N. Y. A solenoid is used to trip the machine and stop it at the end of a cycle, working in conjunction with a limit switch. In this way, the treadle of the machine is omitted and a foot-switch is used instead, requiring very little effort, so that girls can operate the machines without undue fatigue. The foot-switch can be placed in any position best suited to the operator. The limit switch stops the machine at the end of the cycle, eliminating all of the throw-out mechanism previously used. These improvements make it possible to save considerable time in changing a machine from one job to another, as it was formerly necessary to make several adjustments on the mechanical tripping and throw-out mechanisms.

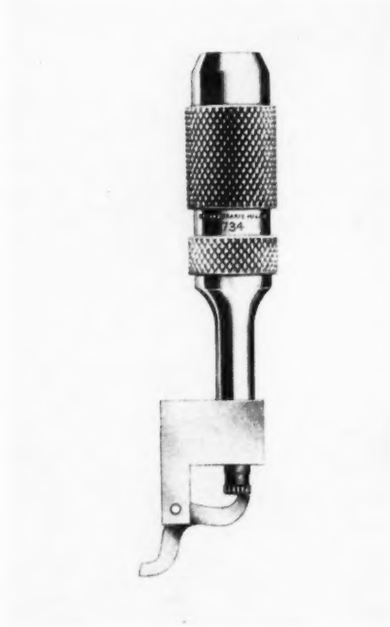
An expanding disk-holder permits laminations to be notched accurately without the use of a keyway. The disk-holder is similar to a split collet. It is opened by means of a draw-in bolt actuated by a solenoid. At the end of the cycle, the draw-bolt is released, permitting the disk-holder to contract and leaving the notched lamination loose on the spindle. This permits easier loading and unloading. Time is also saved in stacking the disks, as it is not necessary to line up the slots in relation to a keyway.....62



Improved Notching Press Built by the V & O Press Co.

Brown & Sharpe Attachment for Dial Gages

The Brown & Sharpe Mfg. Co., Providence, R. I., has recently added to its line of machinists' tools a new universal attachment, designated No. 734B, for use on dial gages having stems 3/8 inch in diameter. This new attachment is designed for testing internal and other surfaces which cannot be reached conveniently with the regular straight spindle of a dial gage. It consists of a small cylinder that clamps over the dial gage stem, a rod within the cylinder which is in contact with the point of the dial gage spindle, and a bell-crank point extending at right angles to the regular spindle.....63

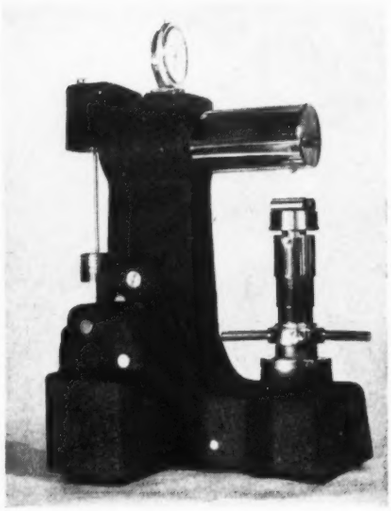


Brown & Sharpe Dial Gage Attachment

Rockwell Hardness Testers

Two new models of Rockwell hardness testers, known as the 3-CR Hardness Tester and the 3-CS Superficial Hardness Tester, designed for internal testing of large tubes and cylinders, have been brought out by the Wilson Mechanical Instrument Co., Inc., 382 Concord Ave., New York City. The cylindrical tube being tested is simply passed over the horizontal testing arm. The machines can also be used for testing outer surfaces. One of the applications of these machines is in the testing of airplane engine cylinders having nitrided surfaces.

These models have an 8-inch vertical capacity, 6-inch horizontal reach, and will test internal surfaces down to 4 inches inside diameter. Correct application of the loads is insured through the patented frictionless, free-floating plunger system and the correctly maintained loads and leverages. The operation is semi-automatic through motor operation.....64

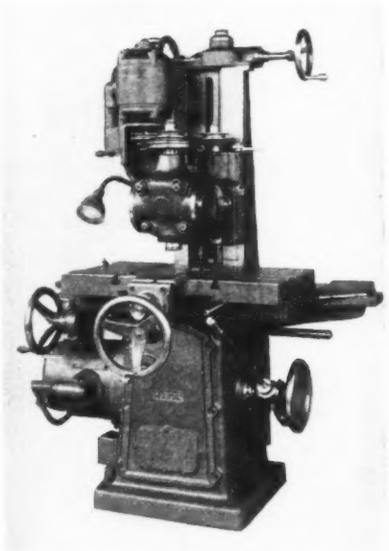


Rockwell Hardness Tester Developed for Internal Testing of Large Tubes

"Pencil-Tex" Drafting Cloth

The Frederick Post Co., P. O. Box 803, Chicago, Ill., has recently introduced to the trade a new pencil drafting cloth designated "Pencil-Tex" which, it is claimed, can be used to produce blueprints that are equal in appearance to those made from ink tracings. This material is similar in appearance to fine tracing cloth, the velvety surface having a remarkable affinity for pencil leads of all degrees of hardness. Even the hardest pencils will leave a sharp, uniform ink-dense line. This intensification, together with a glass-like transparency, is said to make possible the production of blueprints with the sharp contrast of prints made from ink tracings.....65

To obtain additional information about equipment described on this page, see lower part of page 512.



Hack Multi-versal Machine with Vertical Head in Place

Hack Improved Multi-Versal Tool-Room Machines

More than twenty-six kinds of metal-cutting operations can be performed on the improved "Multi-versal" tool-room machine developed by the Hack Machine Co., 440 N. Oakley Blvd., Chicago, Ill. A new feature is the built-in duplicating unit for plastic molds and work of a similar nature. The capacity of the machine has been greatly increased, and many improvements have been made to facilitate rapid performance. The duplicating unit provides for both cylindrical and vertical cutting. Cutters up to 6 inches in diameter can be used in roughing cuts.

The machine is equipped with a vertical reciprocating rear ram, provided with a master head to which attachments and adapters can be instantly fitted, thus combining reciprocating and rotary motion in one machine. The master head is a self-contained horizontal milling unit driven through a V-belt from a motor adjustably attached to the head. This head serves as a carrier for all removable attachments, and is fitted with a central boss around the spindle which serves to locate the attachments. The height of the master-head spindle above the table is from 6 to 20 inches.

In addition to the 2-H.P. motor that drives the ram, there is a 1-H.P. motor for driving the master head and vertical head, and a 1/2-H.P. motor for driving the feed mechanism. The vertical spindle can be operated at speeds of 750, 1200, 1800, and 2500 R.P.M. The vertical head can be revolved 360 degrees around the master spindle.

Some of the operations performed on this machine are: Jig boring; vertical and horizontal milling; angular and vertical slotting; filing; drilling; surface, cylindrical, and internal grinding; broaching; sawing; faceplate and chucking lathe work; cam cutting; lapping; honing; keyseating; gear-cutting; graduating; die-sinking; and engraving. 66

Southwark Aircraft Presses

The Baldwin-Southwark Corporation, Eddystone, Pa., has just completed six hydraulic presses to be used in forming aircraft parts from duralumin sheets. Three of these presses are of 280 tons capacity, and have a 60- by 66-inch platen area and a stroke of 24 inches. They are of the double-acting type, with a clamping and a working platen. The table has a 24-inch hole in the center for deep drawing work, or for the installation of a die cushion or triple-action cylinder if required. One of these presses is shown in Fig. 1. They are operated by a 6-gallon and a 28-gallon pump requiring 55 H.P. for each press. These presses have low-pressure filling systems to permit quick approach of the moving platens to the work.

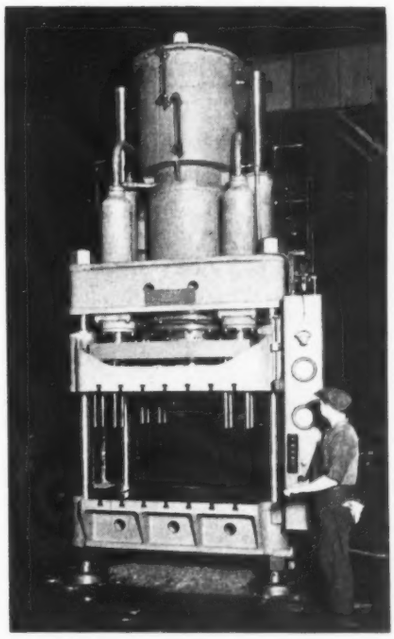


Fig. 1. A Southwark 280-ton Press for the Aircraft Industry

The other three presses are of 2050 tons capacity, a press of this class being shown in Fig. 2. They are also oil-operated and double-acting. These presses are designed with side housings, on which the main moving platen is guided. Above the main moving platen is a clamping platen with clamping pins that protrude through the moving platen. These presses have a stroke of 44 inches. The distance between the housings is 120 inches; the table is 80 inches wide. They are equipped with fully automatic controls. 67

Cutler-Hammer Alternating-Current Torque-Motor Operated Brake

A torque-motor operated brake for alternating-current service on elevators, cranes, hoists, etc., has been developed by Cutler-Hammer, Inc., 264 N. 12th St., Milwaukee, Wis. This brake is designed for applications where positive, quick, cushioned braking is required for stopping or holding a load.

A torque motor operating through a simple anti-friction ball jack releases the brake. When the brake is fully released, the torque motor is stalled across the line. When the circuit is opened, a heavy helical torque spring sets the brake. A slight flywheel action of the rotor provides smooth, cushioned braking. The brake is available in five sizes, with maximum torque ratings of 160, 400, 800, 1600, and 3200 foot-pounds on intermittent duty. Continuous-duty ratings are slightly lower. 68

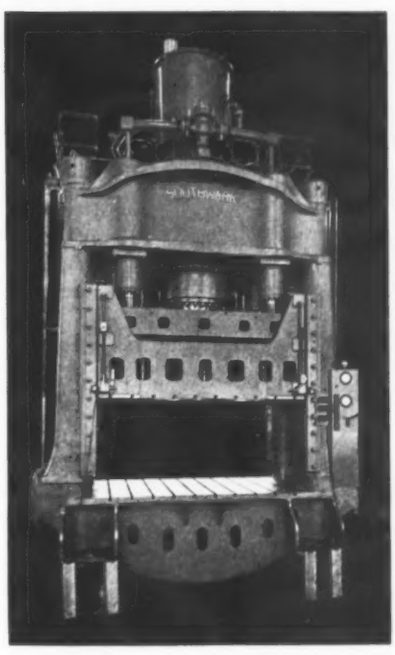


Fig. 2. A Press of 2050 Tons Capacity for Forming Duralumin Sheets

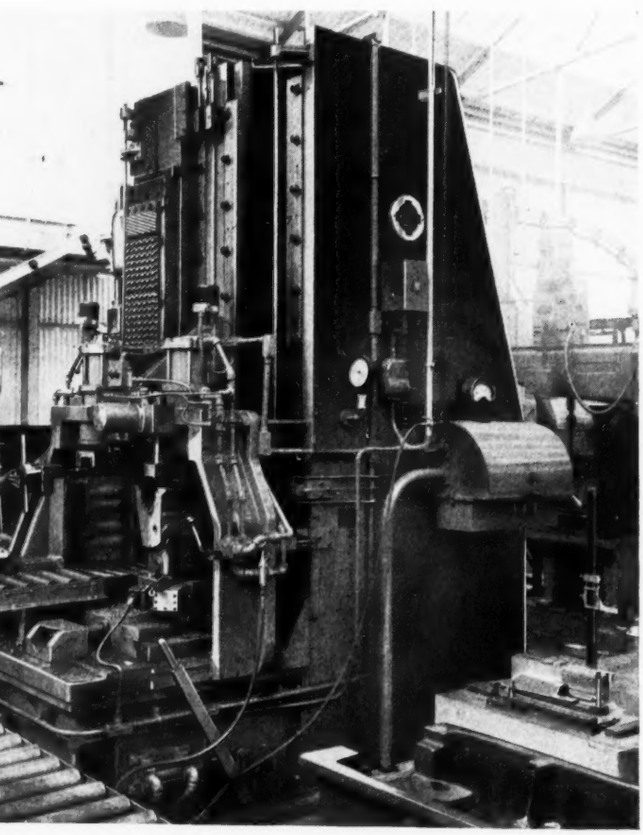
To obtain additional information about equipment described on this page, see lower part of page 512.

Huge Machine for Surface-Broaching Cylinder Blocks

The Lapointe Machine Tool Co., Hudson, Mass., with a branch factory in Edgware, Middlesex, England, has recently furnished equipment for broaching a four-cylinder motor block at the plant of Standard Motors, Ltd., England. One of the machines furnished for this work is the huge vertical double-ram broaching machine here illustrated. This machine is the first of its type to be used in England for the surface-broaching of cylinder blocks. It is hydraulically operated, and is equipped for broaching both ends and the top and bottom surfaces of the blocks.

The two vertical broach slides or rams travel in opposite directions, so that one broach descends during the cutting portion of its cycle while the other broach rises to the upper position, ready for the next cut. The right-hand broach faces the two ends of the casting, and the other broach machines the sump face and the cylinder head joint face. Each of the four faces is machined at one cut, the two ends being broached first before the work is transferred to the second station for the cuts on the sump face and the head joint face. At each of the two stations, the work is turned around for the cut on the second face after the first cut.

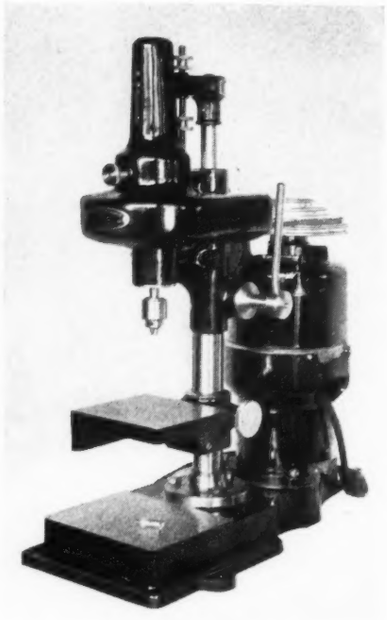
Each ram of this machine has a normal capacity of 30 tons, with a peak load capacity of 36 tons. The maximum stroke is 66 inches. The machine is 5 feet wide by 12 feet front to back, with an over-all height of 15 feet. It is set in a pit 6 feet below the floor level to facilitate operation. The frame of the machine is made of heavy welded steel construction, normalized to relieve welding strains. The weight of the machine is 46,000 pounds. 69



Lapointe Two-station Double-ram Broaching Machine for Surface-broaching Cylinder Blocks

Four-Speed Drilling Machine

The High Speed Hammer Co., Inc., 313 Norton St., Rochester, N. Y., has added a four-speed machine to its line of two- and three-speed models. The four speeds available in the new machine are 750, 1500, 3000, and 6000 R.P.M. The drilling range of the machine is from No. 80 to 1/4-inch drills. Holes 0.010 inch in diameter have been successfully drilled with it.



High Speed Hammer Co.'s Four-speed Drilling Machine

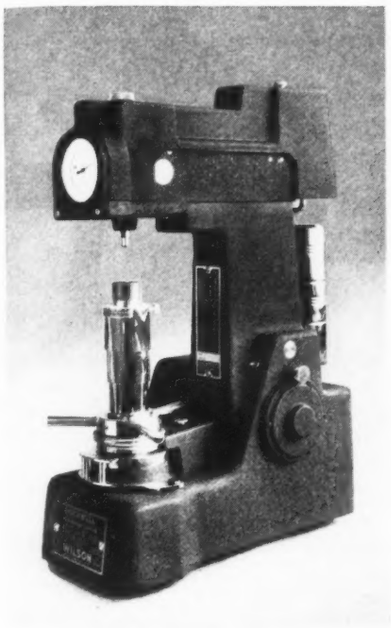
The 750-R.P.M. spindle speed has been added because of the increasing demand for a sensitive drilling machine for tool steels, stainless steels, and other tough alloy steels. This speed is also useful in drilling various non-metallic materials. 70

Kennametal, a New Hard Carbide Cutting Alloy

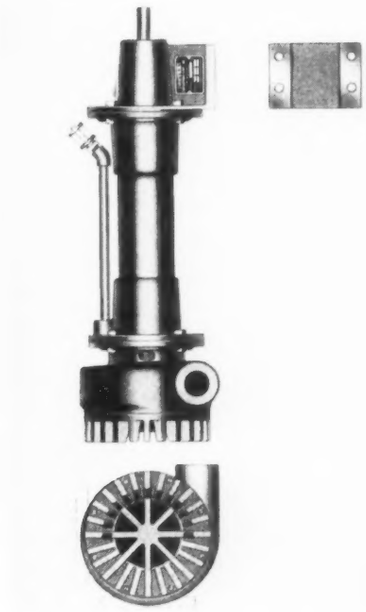
A hard carbide alloy for machining tough metals, such as steel heat-treated up to 500 Brinell, which permits roughing and finishing to be accomplished in one operation, has been placed on the market by the McKenna Metals Co., 147 Lloyd Ave., Latrobe, Pa., under the trade name "Kennametal." The basic ingredient in this cutting alloy is tungsten-titanium carbide. It is suitable for machining steel, Monel metal, malleable iron, cast iron, brass, bronze, aluminum, and many other materials.

Kennametal is available in three standard styles of blanks from which tools can be tipped by the user, or it can be obtained in other than standard blanks. An assortment of eighteen styles of Kennametal-tipped tools for operations such as reaming, boring, tapping, milling, gaging, etc., is also available. The alloy is suitable for the high cutting speeds generally used with carbide tools, and will produce the same unusually large number of pieces per grind of which the carbide tools are capable. 71

To obtain additional information about equipment described on this page, see lower part of page 512.



Motorized Rockwell Hardness Tester for Production Testing



Pioneer Coolant Pump with Bracket for Attaching Unit to Tank

Motorized Rockwell Hardness Tester Designed for Production Testing

The Wilson Mechanical Instrument Co., Inc., 382 Concord Ave., New York City, is placing on the market a Model Q motorized Rockwell tester designed for use where hardness testing requirements call for 100 per cent production testing of parts made in large quantities or where a large percentage of the parts produced must be tested. This new tester is made in a QR model for regular hardness testing, and in a QS model for superficial hardness testing.

These motorized hardness testers have a vertical capacity of 8 inches. The readings obtained are identical with readings obtained with the hand-operated Rockwell testing machines. The motorized feature, however, makes it possible to increase the testing speed up to the highest point consistent with accurate and reliable results. The readings made with these testers are absolutely independent of variations in the thickness of the pieces tested. 72

Pioneer Coolant and Lubricant Pumps

A new series of coolant and lubricant pumps will be shown at the Machine and Tool Progress Exhibition in Detroit, by the Pioneer Engineering & Mfg. Co., 31 Melbourne Ave., Detroit, Mich. These units are designed especially for use in conjunction with machine tools or auxiliary tanks where the unit must be driven with a flat or V-belt, chain, gear, or flexible coupling, or where it is impossible to mount the motorized models. The pumps are particularly adapted for export or for use where the electrical current available varies or will not operate a pump motor at the speed required to maintain the delivery capacity of the unit.

This series includes models designed to be submerged in the tank or attached to the side of the tank or machine, as required. All of these units are built in capacities up to 175 gallons per minute and pressures up to 53 pounds per square inch. They are of the open impeller type, which permits the use of filters. Abrasives or other foreign matter in the liquid being pumped will not impair the efficiency or life of the pumps. 73

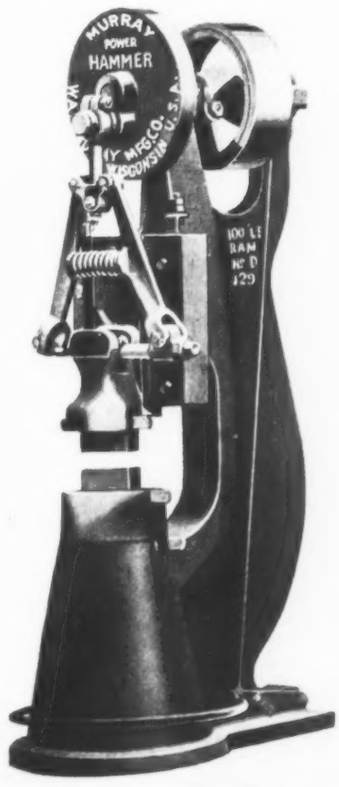
Diehl Heavy-Duty Bench Grinder

A bench type grinder for use in heavy-duty manufacturing operations, tool sharpening, general shop work, and wire-wheel brushing and buffing, equipped with a "Diehl-Lite" for lighting the work, has been brought out by the Diehl Mfg. Co., Elizabethport, N. J. This grinder, known as the "DeLuxe," is similar in construction to the standard heavy-duty type made by this company, which was described in June, 1937, MACHINERY, page 700, except for the addition of the Diehl-Lite and eye shields, which increase the usefulness of the grinder where direct lighting on the work and protection from flying particles are essential.

The Diehl-Lite is instantly adjustable to any desired operating position, and throws a powerful nonglare light directly on the work, with diffused lighting on the surrounding areas, thus eliminating sharp shadows. The eye shields are equipped with shatter-proof glass. 74

Murray Power Hammer

The Murray power hammer, formerly known as the "Mayer-Moloch," is being placed on the market by the J. D. Murray Mfg. Co., Wausau, Wis., in five sizes, with rams ranging in weight from 25 to 500 pounds. These machines are available with either belt or direct motor drive. Improvements have been made in the frame design of these machines to increase their rigidity. The accurately balanced rams operate in long and wide V-guides. Large bearings are provided for the tee or toggle bolts. 75

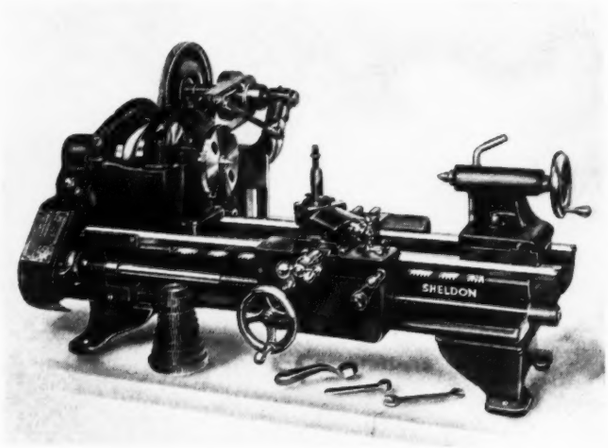


Murray Power Hammer with 100-pound Ram

To obtain additional information about equipment described on this page, see lower part of page 512.

Sheldon 10-Inch Screw-Cutting Lathe

The Sheldon Machine Co., Inc., 3261 S. Cottage Grove Ave., Chicago, Ill., has placed on the market a low-priced, back-geared, screw-cutting precision lathe, designed particularly for small shops and tool-rooms, garages, and home craftsmen. The new lathe, which is known by the trade name "Metal Worker," has a 10 1/8-inch swing, with distances between the centers of 20 or 26 inches, and bed lengths of 38 or 44 inches.



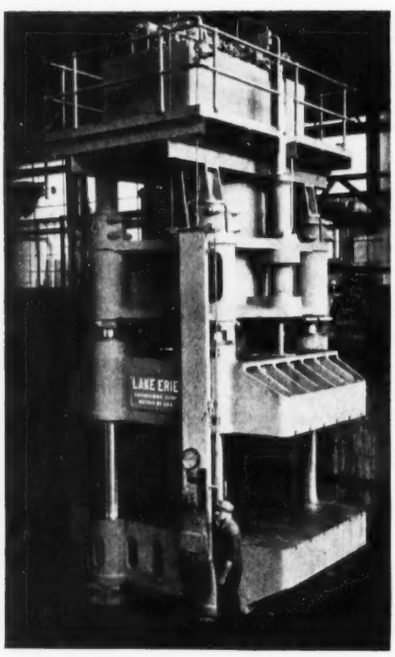
Sheldon 10-inch Screw-cutting Lathe

Among the features of the machine, the manufacturer points out the following: Hob-cut semi-steel or steel change-gears; over-size hardened steel spindle, ground all over with 1 1/16-inch hole through its entire length; and a heavy, semi-steel base with hand-scraped ways. 76

Huge Press for Forming Airplane Wing Sections

The 2500-ton capacity press here illustrated is one of fourteen presses of various sizes shipped to the French Air Ministry by the Lake Erie Engineering Corporation, Buffalo, N. Y., for use in forming duralumin sections of airplane wings, pontoons, and fuselage parts. The press illustrated weighs 392,000 pounds and required six freight cars for its transportation.

The ram of the press is 42 inches in diameter, and the platens are 150 by 89 inches. The entire press is a self-contained unit, with electrically driven pumps mounted on its upper deck. The adaptability of machines of this design for blanking, drawing, and forming parts of a wide variety of sizes and shapes in both limited and large-volume production has been responsible for their general use in sheet-metal fabrication plants. 77



Huge Press Built by Lake Erie Engineering Corporation

Totally Enclosed Vertical Speed Reducer

A totally enclosed differential speed reducer which can be supplied in practically any ratio without changes in dimensions has been placed on the market by Winfield H. Smith, Inc., Springville, Erie Co., N. Y. This No. 40 differential speed reducer is equipped with a 1 1/2-H.P. motor having a speed of 1725 R.P.M. The output shaft speed is 5 R.P.M.

This speed reducer is Timken-bearing equipped, and has heat-treated alloy steel gears. Any make of motor can be used, the motor shaft being connected to the high-speed shaft of the speed reducer by a flexible coupling. 78

"Aqua Sol" Machining Lubricant

A machining lubricant known as "Aqua Sol C" compound has been placed on the market by the Wayne Chemical Products Co., 9502 Copeland Ave., Detroit, Mich. It is especially adapted for use in broaching, for lathe work, and, in general, for machines where a high-grade machining lubricant is required.

The compound mixes readily with water; the average solution is a mixture of from eight to ten parts of water to one part of base compound. Great savings in cutting compound costs are claimed to result from the use of this solution. Being a water soluble solution, it is efficient as a coolant, as well as a lubricant. A high finish is secured on parts being broached or otherwise machined. 79

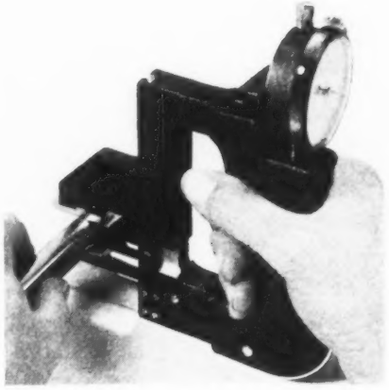
Federal Adjustable Snap Gage

An adjustable snap gage that indicates the exact size variation directly has been placed on the market by the Federal Products Corporation, 1144 Eddy St., Providence, R. I. This gage has been designed to eliminate the necessity for depending on the uncertain "feel" of the operator.

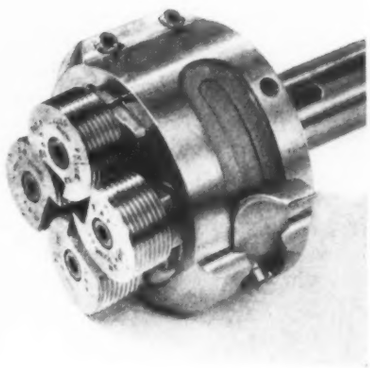
The upper jaw of the gage is adjustable to the size of work being gaged and is held rigidly in position. The lower jaw comprises one

Vertical Type Speed Reducer Made by Winfield H. Smith, Inc.

To obtain additional information about equipment described on this page, see lower part of page 512.



Federal Adjustable Gage that Eliminates "Feel" of the Operator



National Acme Die-heads for B & S Automatics

end of a simple lever, the opposite end of which makes direct contact with the indicator point. This construction provides a simple direct transfer of the lower jaw motion to the indicator. The jaws have tungsten-carbide inserts, and the face of the back-stop is located at an angle, which automatically centers the work, regardless of its diameter. The indicator has a range of 0.200 inch, a maximum jaw opening of 2 1/2 inches, and a minimum jaw opening of 1 inch. The indicator dial has 0.0001-inch graduations. 80

National Acme Die-Heads

Die-heads for Brown & Sharpe automatics, built in 1/4-, 3/8-, and 9/16-inch sizes, have been brought out by the National Acme Co., 170 E. 131st St., Cleveland, Ohio. These die-heads use the company's standard and special ground-thread circular type chasers.

Among the new features of the die-head construction is an adjustable compensating float which cushions the chasers, preventing torn or distorted threads at high spindle speeds. Two methods of closing the die are provided. The head is either held closed under tension while the turret indexes or it is closed in the last position, just prior to threading, by a simple stop which arrests the forward travel of the die slide.

The adjustment to cutting size is by means of two screws which move all the circular chasers (with holding blocks intact) uniformly and at the same time. The circular chasers are removed for resharpening by loosening one screw. They are sharpened in a sizing micrometer fixture, so that, when returned to the head, the cutting size is not changed and no adjustment is necessary. The chasers can be replaced by cutters and holding blocks for hollow milling and forming. 81

"Thor Drillmaster" Portable Electric Drill

A light-duty, 1/4-inch electric drill known as the "Thor Drillmaster" has been brought out by the Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. The new drill weighs only 4 pounds, and is but 12 inches in length over all. It is a light-duty tool, designed for general intermittent service in maintenance and installation work. Because of its torpedo-like design, it can be used conveniently in hard-to-reach places.

The free speed of the drill is 2000 R.P.M. The equipment includes a 1/4-inch, three-jaw Jacobs chuck, a grip handle with recessed thumb-control switch, and a three-conductor cable with ground wire and plug. 82

"Production" Abrasive Belt Surfacer

An abrasive belt surfacer which can be used either in a vertical or horizontal position, and which can be clamped and used in any intermediate position, has been developed by the Production Machine Co., Geenfield, Mass. All the adjustments necessary for changing from one position to another are made on the outside of the guard in a few seconds.

The machine is completely enclosed, except the belt; the front or working side of the guard can be removed for changing belts, which is quickly and easily done. The belt tension is controlled by a handwheel, locked in position when set. An exhaust connection is provided to which a vacuum cleaner bag may be attached.

The main shaft is provided with a 4-inch drive pulley for a V-belt. The surface speed of the abrasive belt is approximately 2300 feet per minute. The work or belt table is 15 inches long by 6 inches wide. The endless abrasive belt is 50 inches long by 6

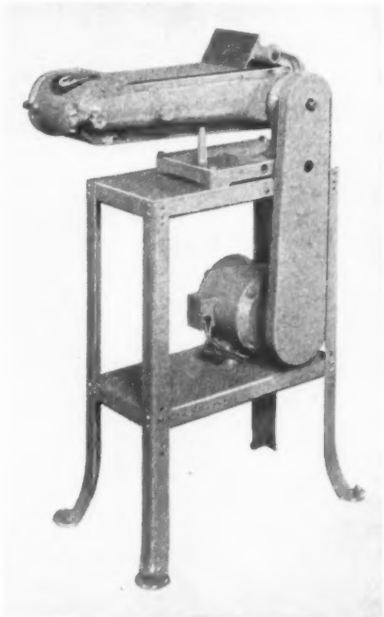


Fig. 1. Abrasive Belt Surfacer in Horizontal Position

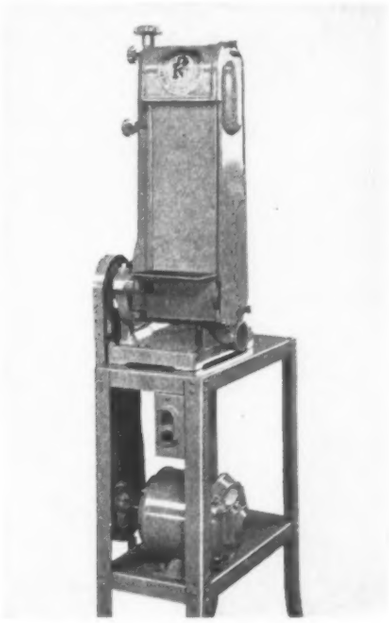


Fig. 2. Belt Surfacer Adjusted for Use in Vertical Position

To obtain additional information about equipment described on this page, see lower part of page 512.

inches wide. The drive is from a 3/4-H.P., 1725-R.P.M. motor. The floor space required is 15 by 30 inches. 83

Jones & Lamson Comparator and Measuring Machine

The Jones & Lamson Machine Co., Springfield, Vt., has brought out a new model of their comparator and measuring machine which has a screen 30 inches in diameter. This large screen permits the optical inspection of large objects at suitable magnifications. Typical parts for which the machine is suited are large forming tools, cutters, hobs, taps and gages, etc. The following lenses are available: 20X, 30X, 50X and 100X.

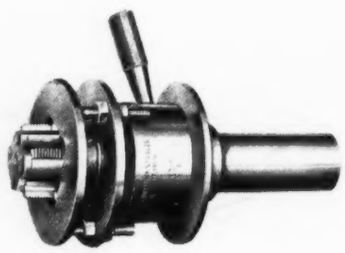
The periphery of the ring that supports the screen is graduated in 1/2 degrees, reading with a vernier to one minute of arc. The machine will accommodate objects up to 8 inches in diameter by 21 inches long, and has provision for measuring 4 inches on the coordinates.

Any one of three types of tables can be furnished—a plain table without lateral adjustment, a table with a 4-inch lateral travel, and a table with an 8-inch lateral travel. The table can be swiveled to position the helix of hobs and taps in a plane normal to the axis of the lens system. Lead measurements on the table with lateral travel can be accomplished by the use of the micrometer attached to the table, by spacing blocks, or by end-measuring bars. An attachment can be supplied for measuring by reflection surfaces that cannot be projected. 84

Jones & Lamson Comparator with 30-inch Screen

Murchey Collapsible Machine Tap

A collapsible machine tap designed for tapping straight threads, which can be used either as a rotating or a stationary tap, has been brought out by the Murchey Machine & Tool Co., 951 Porter St., Detroit, Mich. It can be used with the handle, as a non-rotating tap on turret lathes and hand screw machines; or without the handle, as a rotating tap on drill presses and tapping machines. The collapsing mechanism is instantaneous in action, insuring threads of accurate lengths under all conditions. The trip-ring is adjustable for various thread lengths. The collapsed tap can be reset by means of the handle or the expanding collar.



Murchey Type M Collapsible Machine Tap

The size-adjusting mechanism of the tap consists of an adjusting screw located at the rear end of the center pin. A simple turn to the right or left expands or contracts the chasers on the center pin to the correct cutting point. The adjusting pin is then securely locked, so that the chasers will permanently retain their setting. This adjustment can be made quickly without removing the tap from its spindle.

This tap, known as Type M, is made in eleven sizes, covering a range of from 1 1/4 up to 4 1/2 inches. The 1 1/4-inch size has a capacity for cutting straight threads from 1 1/4 to 1 3/8 inches in diameter, while the largest, or 4 1/2-inch size, has a capacity for cutting straight threads from 4 3/8 to 5 1/2 inches in diameter. All sizes up to the 4-inch size have four chasers, the 4- and 4 1/2-inch sizes being provided with six chasers each. 85

Leeds & Northrup Temperature Indicator

Leeds & Northrup Temperature Indicator

A new switchboard model temperature indicator with self-contained toggle type switches for connecting any one of a number of couples to the measuring circuit has been brought out by the Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia, Pa. This indicator, installed in any convenient location, enables an operator to measure temperatures of near and distant couples.

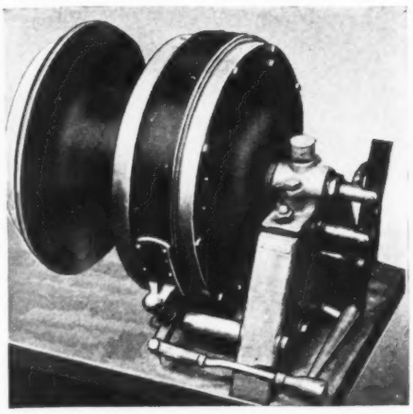
The scale is practically uniform and equally accurate throughout and can be calibrated for single or double range indicating. Built-in terminals, check key, and mercury thermometer can be included for checking with a portable indicator.

The rigid metal case can be mounted flush in the panel or it can be equipped with hangers for surface mounting. The only expense for maintenance is the occasional replacement of the dry cell. A red disk appears above the indicator scale as a warning when replacement of the dry cell is necessary. Separate selector switches can be used outside the indicator, if desired, or space for additional self-contained toggle type switches can be obtained by removing the case and assembling the indicator in a cabinet. 86

Fray-Mershon Hydraulically Operated Clutch

A new type slow-speed, heavy-duty hydraulic clutch has recently been developed by Fray-Mershon, Inc., 515 W. Windsor Road, Glendale, Calif. This new "Hydra-Clutch," as it is known, is particularly adaptable for all operating conditions on such work as bulldozing, carry-all work, winches and hoists, as well as for use on all types of power take-off units.

To obtain additional information about equipment described on this page, see lower part of page 512.

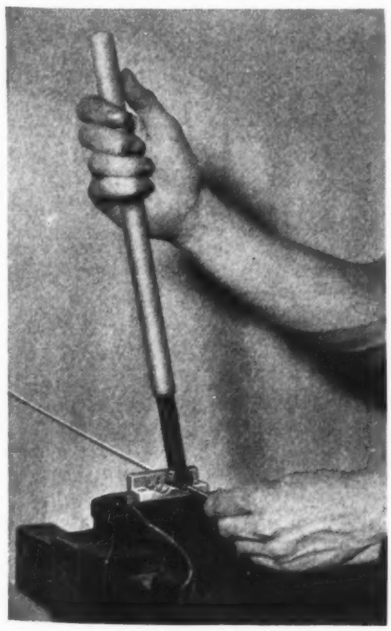


Hydraulically Operated Clutch Made by Fray-Mershon, Inc.

The hydraulic clutch, which has a self-energizing feature, operates entirely on oil and has no clutch plates or lining. Its operation is said to be unaffected by changes in climatic conditions. The clutch is entirely enclosed, is water- and dust-proof, and is adapted for remote control. It is said to be free from drag, and will operate in a vertical or horizontal position. 87

Billings Cut-Off Tool for Round Stock

A cut-off tool suitable for use in tool-rooms, tool cribs, garages, and other places where drill rod, wire, or small-diameter bar stock must be cut, has been brought out by the Billings & Spencer Co., Hartford, Conn. This tool will cut off drill rod and wire up to 1/4 inch in diameter without leaving a burr. It can be secured to a work-bench permanently or can be set up in a vise in a few seconds.

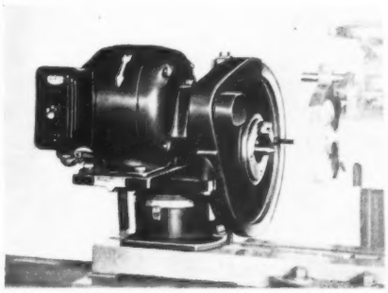


Billings Cut-off Tool for Small Round Stock

The operating lever is 15 3/4 inches long and 7/8 inch in diameter. It is finished in gray "Duro" finish with a bright red end. The cut-off cam and block have a rustproof finish. 88

Brown & Sharpe Revolving Spindle Headstock

A revolving spindle headstock, available as an attachment for use on the company's No. 10 cutter and tool grinding machine, has been developed by the Brown & Sharpe Mfg. Co., Providence, R. I., in order to provide a means for performing straight or taper cylindrical grinding. The centers will swing work up to 10 inches in diameter, 17 inches long. The maximum length of the grinding stroke is 10 inches. In addition, miscellaneous chucking operations are made possible by the use of a 4-inch, four-jaw, independent chuck which can be mounted on the face of the spindle pulley in place of the work-driver.



B & S Revolving Spindle Headstock for Cutter Grinding Machine

The spindle unit is driven by a single V-belt from 1/4-H.P. constant-speed motor mounted on the headstock. The spindle speed is 300 R.P.M. when using a 60-cycle alternating-current or a direct-current motor. The headstock swivels on its base, and can be set at any angle in a horizontal plane, the setting being indicated by a scale graduated to 100 degrees each side of zero. The rigid base is aligned accurately on the swivel table of the machine by means of two tongues, and is clamped in position by two T-bolts which fit the angular table slot. 89

"Electro Lift" Two-Speed Hoists

A two-speed alternating-current hoist designed to give slow speeds for starting, "inching," and stopping, and fast speeds for rapid handling, has been brought out by Electro Lift, Inc., 30 Church St., New York City. The hoist is especially suitable for serving machine tools, foundries, furnaces, etc., and for handling rubber molds, concrete forms, and similar parts. It is built in sizes from 1/4 ton to 6 tons, in both single and twin hook types, the latter for handling long loads. The control can be of either rope or push-button type. 90

Pollard Stacking Boxes

Steel stacking boxes for use in all types of industrial plants have just been added to the line of factory equipment made by the Pollard Bros. Mfg. Co., 5507 Northwest Highway, Chicago, Ill. The stacking rim on all four sides of these boxes is made by a series of bends in the steel itself, in order to increase the strength of the box and prevent the stacked boxes from telescoping or becoming dislodged. Delicate parts can be stored in these boxes without danger of crushing. All the corners are reinforced by steel bands. Either a rigid handle or a drop type handle

Fig. 1. Pollard Stacking Box

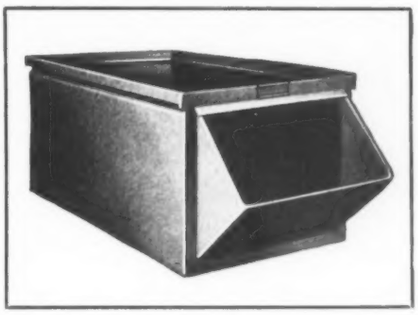


Fig. 2. Pollard Open-end Stacking Box

To obtain additional information about equipment described on this page, see lower part of page 512.

Fig. 1. Red Ring Gear Speeder for Detecting Objectionable Noise in Rotating Gears

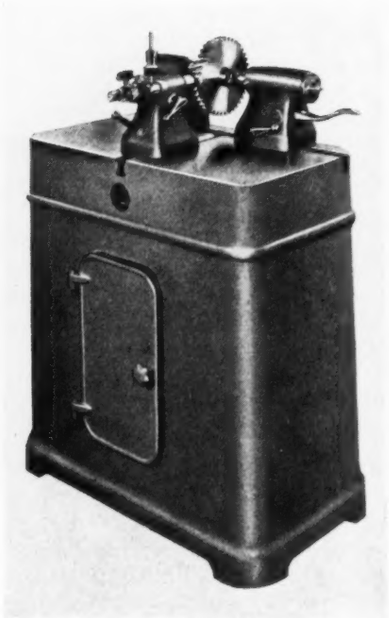


Fig. 2. Universal Gear Tester for Checking Helix Angle, Eccentricity, and Tooth Size of Gears

is furnished, as desired. These boxes can be made in any size to meet requirements, and from steel in gages ranging from 16 to 22.

Open-end stacking boxes for use in stock-rooms in place of shelving and for general factory use are also available. These boxes are constructed the same as the other stacking boxes, with the exception that one end is open, making parts readily accessible when the boxes are stacked on each other. A label-holder is provided for identification tags. The open-end box will stack with the other type stacking boxes of the same size, and can be made in any size to meet requirements. 91

National Gear Testing Equipment

The line of Red Ring gear testing equipment to be shown at the Machine and Tool Progress Exhibition in Detroit by the National Broach & Machine Co., 11457 Shoemaker Ave., Detroit, Mich., will include the gear testing machines shown in Figs. 1, 2, and 3. The Red Ring gear speeder, shown in Fig. 1, is designed for rapid testing to detect objectionable noise in a set of gears operating at high speed. The gears being tested are run at high speed inside of an acoustical chamber. The horn of this chamber, to which the operator applies his ear, multiplies the sound so that any objectionable noise is detected at once. Noisy gears are thus kept out of the assembly line.

The Red Ring universal gear tester, shown in Fig. 2, is built for the rapid checking of gears for index, interference, helix angle, wobble, eccentricity, and tooth size. It permits accurate checking of all these factors in less than a minute, making it useful for production inspection. This equipment can be easily and quickly set up for testing any gear. Helical or regular gears can be accommodated.

The lead of helical gears can be accurately checked against a master gear or a master disk by means of the Red Ring helical gear lead tester, shown in Fig. 3. The master and work gear are mounted rigidly on the same axis for testing. A fixed ball point contacts with the master and a similar recording point contacts with the tooth of the work gear. Sliding the head of the tester causes the fixed ball point to rotate the gears as it moves across the master tooth. The recording point shows the lead error on an indicator. 92

High Precision Measuring Machine for Shop Use

A shop precision measuring machine, designed to permit Bureau of Standards measuring methods to be employed in actual shop practice, has been brought out by the Societe Genevoise d'Instruments de Physique of Geneva, Switzerland, and is being placed on the market in this country by the Triplex Machine Tool Corporation, 125 Barclay St., New York City. This equipment, designated the MUL-250 Shop Gage Measuring Ma-

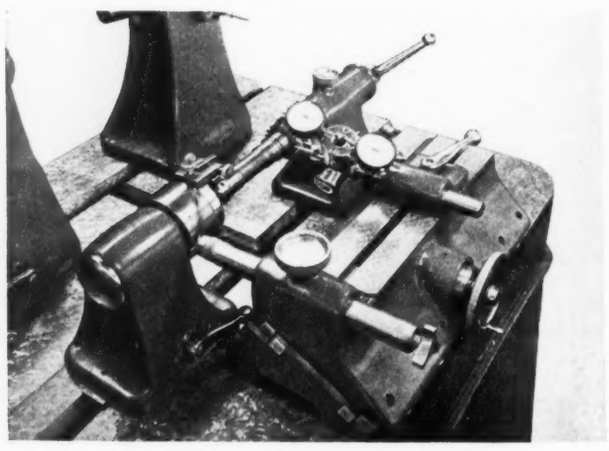
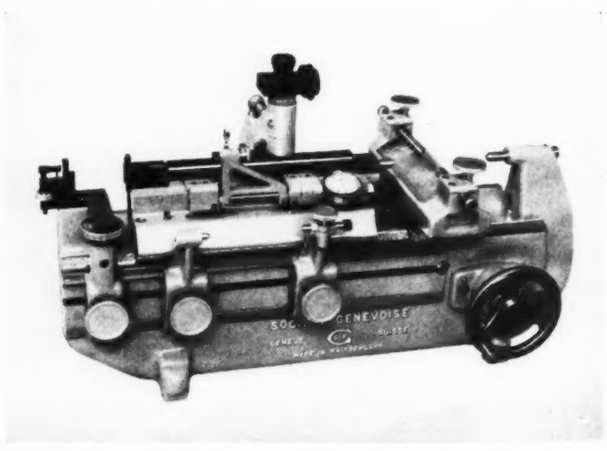


Fig. 3. Red Ring Helical Gear Lead Tester



Precision Measuring Machine Built for Shop Use

To obtain additional information about equipment described on this page, see lower part of page 512.

chine, makes possible direct measurement, inspection, and checking of all production gages with a degree of accuracy that is generally possible only in the laboratory. Universal fixtures provide for the measurement of all types of gages and tools in use in precision manufacturing methods, including precision thread gages.

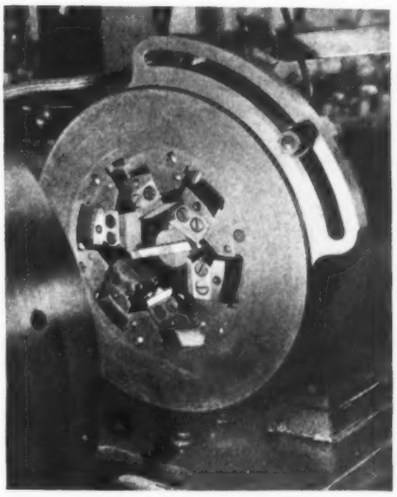
A universal measuring machine, designated MU-214B, which is similar in principle to the one here illustrated, is made by the same company. This is a wide-range universal precision measuring device, adapted for inspecting and testing a variety of production parts, tools, and gages. 93

Special Reaming and Chamfering Fixture for Landis Pipe Threading Heads

The Landis Machine Co., Inc., Waynesboro, Pa., has just brought out a special reaming and chamfering fixture for use in its 4-, 6-, and 8-inch stationary pipe die-heads. This fixture is designed to perform the reaming and chamfering operation during the threading operation. It can be used for pipes of all diameters within the capacity of a head.

The fixture can be applied to any Landis pipe threading and cutting machine employing die-heads of the sizes given. It consists of a driver, which is gripped in the pipe support at the rear of the cross-rail; a centering ring which fits the bore of the cross-rail, supporting the driver in its proper position; and a pressure spring within the driver, which exerts force against a reaming tool-holder having a sliding fit within the bore of the driver. This assembly is held together by a draw screw which passes through the driver to the opposite end, where it can be adjusted to vary the spring pressure.

A separate reaming tool is required for each pipe size. The tool is supported and locked in position



Landis Reaming and Chamfering Fixture for Pipe Heads

in the reaming tool holder by a hexagonal-head cap-screw. Several tool-holders can be employed to cover the complete range of a head. 94

New Tools Added to the Starrett Line

A gage for measuring holes and internal dimensions that are too small to be measured with ordinary telescoping gages is one of several recent additions to the line of the L. S. Starrett Co., Athol, Mass. These new gages are available in sets of four, covering a range of from 0.125 to 0.5 inch. The end of each gage is in the form of a split ball, as shown in Fig. 1. This ball is expanded by a cone controlled by the knurled knob at the end of the gage handle. The ball is expanded in the hole and the measurement transferred to a micrometer.

New models have also been added to the "Last Word" line of indicators made by this company, so that the complete line now includes gages with ranges of 0.024, 0.025, 0.030, and 0.040 inch, calibrated to read in thousandths or ten-thousandths inch, or in metric readings. These gages are made with fixed, friction, or ratchet joint contact points; with large or small dials; with gooseneck or universal shanks; and with fixed or swiveling tubular bodies.

Another new development is the precision gage for planer and shaper work shown in Fig. 2. This gage has been developed to meet the demands for a planer and shaper gage of greater accuracy than the original gage of this type patented by the L. S. Starrett Co. The new gage is set to a micrometer, surface gage, or caliper, and the planer or shaper tool brought into contact with it. The range of this gage with the 3-inch extension is from 1/4 inch to 9 inches. The level built into the base of the gage is useful in setting up work on a planer table.

New Starrett micrometers are made in stain-resisting, longer wearing materials. The No. 436 enameled frame micrometer, for example, is now made with the sleeve and thimble of stainless steel. This model is made in a complete range of sizes, from 0 to 24 inches, and can be graduated to read in either English or metric measure.

The Starrett "Wiggler," or center finder, shown in Fig. 3, is another new product designed for use on jig and tool work in milling machines, drill presses, and similar vertical machines where it is necessary to locate working points with considerable accuracy. It consists of a spring-tensioned pointer held in a tapered shank. With the center finder set in the chuck or tool-holder of the machine, it is a simple matter to bring the working point of any job into accurate alignment with the machine spindle. The tension of the spring which bears on the ball at the end of the pointer can be adjusted by a screw in the back of the shank. ..95

Fig. 1. Starrett Split-ball Type Gage for Small Holes

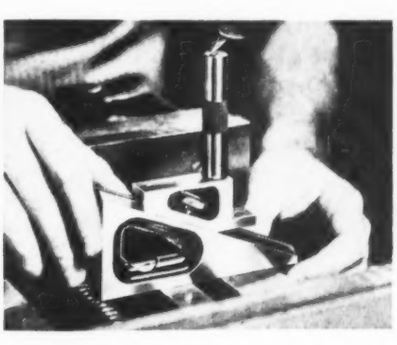


Fig. 2. Starrett Precision Gage for Planer Work

Fig. 3. Starrett "Wiggler" for Aligning Work with Machine Spindle

To obtain additional information about equipment described on this page, see lower part of page 512.

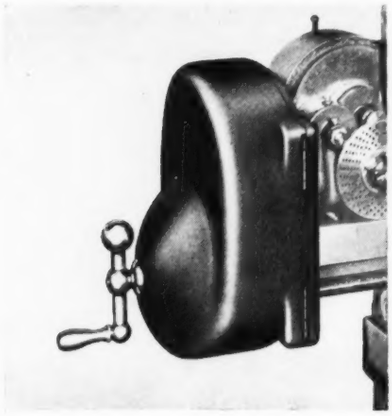


Fig. 1. Brown & Sharpe Change-gear Guard for Milling Machine

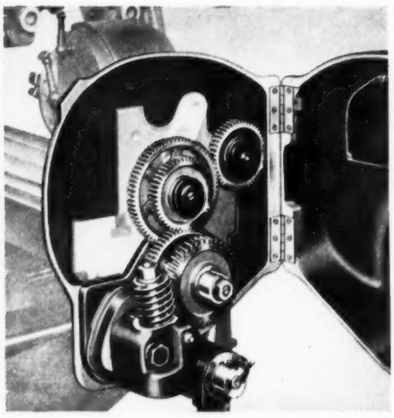


Fig. 2. Brown & Sharpe Short-lead Attachment for Milling Machine

Brown & Sharpe Grinding Machine and Attachments for Milling Machine

The Brown & Sharpe Mfg. Co., Providence, R. I., has recently brought out a No. 23 electrically controlled 10- by 48-inch plain grinding machine. This machine is identical in design and operation to this company's No. 22 10- by 36-inch electrically controlled plain grinding machine, except that it has a capacity of 48 inches between centers. The floor space required is approximately 75 by 152 inches. The weight of the machine is about 10,000 pounds.

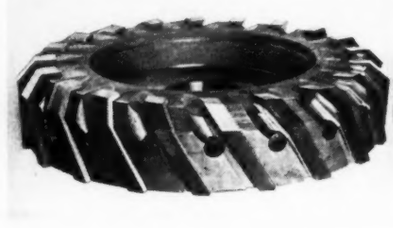
Another new development of this company is the change-gear guards provided for the drive to the universal spiral index-centers of the Nos. 0, 2, and 3 milling machines. These hinged aluminum-alloy guards can be quickly attached and removed. They are designed particularly for use where the lead of the spiral being cut is such as to cause the gears to rotate at a dangerous speed. The guard allows a standard set of change-gears to be used, the hinged construction permitting the cover to be opened wide for changing gears.

On machines provided with power fast travel for the table, the safety hand-crank is removed and longitudinal adjustments are made by means of a handwheel. On machines not provided with power fast travel, a shaft extension and hand-crank, as shown in Fig. 1, are furnished for use with the guard closed.

A No. 20 short-lead and feed-reducing attachment is another new development of this company, which provides a convenient means of obtaining much shorter leads than can be cut by using the change-gears regularly furnished with the universal spiral index-centers. This attachment is designed for use on Brown & Sharpe No. 2 light type universal milling machines beginning with the serial No. 6741. It also permits very fine longitudinal table feeds to be obtained. In using the attachment, the regular drive to the table is disengaged by a clutch provided on the machine, and the screw is driven instead through a worm and wheel and spiral change-gears which provide three different ratios—namely, 1/20, 1/200, and 1/400 of the feed rate for which the machine is set. The gearing is carried on a bracket mounted at the left-hand end of the machine table in place of the table-screw dial bracket. When used as a short-lead attachment, leads from 0.01250 inch to 3.0000 inches can be obtained. 96

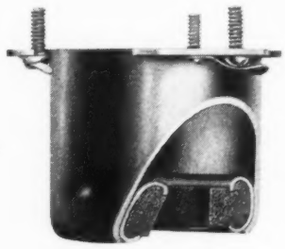
Ingersoll "Shear Clear" Face Mills

One of the most important factors in cutting tool design is the provision of adequate chip clearance. This has usually been obtained in the case of milling cutters by employing coarse tooth spacing. The new "shear clear" face mills, to be shown at the Machine and Tool Progress Exhibition in Detroit, Mich., March 14 to 18, by the Ingersoll Milling Machine Co., Rockford, Ill., have been designed to solve the problem of chip removal in face mills by a new method. The cutting edges of these new mills have been set at cutting angles which cause the chips to move outward, away from the surface being cut. This eliminates any packing of chips in the face of the cutter, and prevents the finished surface from being scored by chips.



Ingersoll "Shear Clear" Face Mill

The cutting blades are set at negative rake and steep positive shear angles. The corners of the cutters are also chamfered to direct the chips outward. The combination of the angles and chamfer is varied to suit the work. This arrangement provides a very free cutting tool, and in some cases, has considerably increased the amount of work that can be handled between grinds. These face mills are made with inserted-blade cutters of high-speed steel, J-metal, and cemented-carbide blades. 97



Wiesman Guide-pin Cover with Felt Washer

Wiesman Guide-Pin Cover

A new guide-pin or leader-pin cover for dies has been developed by the Wiesman Mfg. Co., 4th and St. Clair Sts., Dayton, Ohio, which has a felt washer arranged as shown in the illustration. This new cover is particularly adapted for use on automatic presses which may require the guide pins to be oiled as often as every thirty minutes. The guide-pin cover with the felt washer, when filled with a heavy lubricating oil, will require filling only about every 100 hours. 98

Grob Butt-Welder for Saw Blades

A butt-welder for saw blades from 1/16 to 1/2 inch in width has recently been added to the line of electric butt-welders made by Grob Bros., Grafton, Wis. This small size welder

To obtain additional information about equipment described on this page, see lower part of page 512.

Butt-welder for Saw Blades, Made by Grob Bros.

can be easily transported to the job, thus taking care of an entire battery of sawing machines. It will be exhibited for the first time at the Machine and Tool Progress Exhibition, to be held in Detroit, Mich., March 14 to 18. This welder can be furnished either with or without a portable stand.

The saw blade clamps are of an entirely new design which permits accurate alignment of the saw blade, and the full electrical contact required to obtain a good weld. The saw guides are adjusted so that the teeth of the blades are outside of the clamp, only the flat part of the blade being gripped in the clamp. An eccentric arrangement automatically adjusts the clamps to suit the thickness of the saw blades. After the blade has been welded and annealed, it is removed from the clamps for grinding. The welding flash is quickly removed by a built-in grinding unit. The welder is 12 inches high, 8 inches wide, and 8 1/4 inches deep. 99

Presto Vernier Scale Attachment for Lathe

The Presto Tool Mfg. Co., 518 Newport Ave., N., Detroit, Mich., has recently brought out a lathe attachment designed to show the operator at a glance, how far the carriage or the tool has traveled or how far it still has to go. This attachment, designated the "Presto Vernier Scale," is adapted for use in turning, boring, facing or threading operations. It consists essentially of a carriage, adapter, slide, lock, adjusting screw, scale bar, and locking screw, and can be applied to any lathe having a 90-degree V-type bed by using the wiper holes or by securing the attachment to the carriage.

In using this device, the operator brings the tool up to the work-piece, slides the attachment to zero, and turns the locking screw. As the carriage advances, the scale moves through the slide, which is graduated with 0, 1/64, 1/32, and 3/64 inch marks. The scale itself has 1/16-inch graduations. These graduations permit the operator to work to readings of 1/64 inch. 100

Rotor High-Cycle Drills, Screwdrivers, and Nut-Setters

A complete line of high-cycle electric drills, screwdrivers, and nut-setters, ranging in capacity from 3/16 to 3/4 inch, has been brought out by the Rotor Tool Co., 17325 Euclid Ave., Cleveland, Ohio. These tools will be exhibited for the first time at the American Society of Tool Engineers' Show in Detroit, beginning March 14.

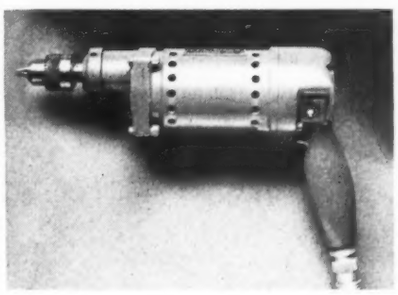


Fig. 1. Rotor High-cycle Drill of 1/8 Inch Capacity

Fig. 2. Spade-handle Drill of 1/2 Inch Capacity

Fig. 3. Side-handle Drill of 7/16 Inch Capacity

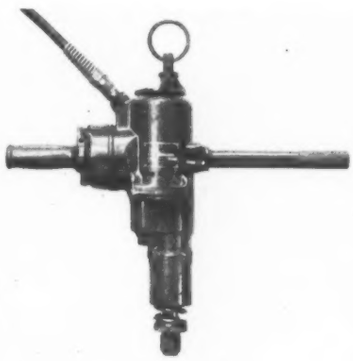


Fig. 4. Side-handle Nut-setter of 1/2 Inch Capacity

Fig. 5. One-quarter-inch Nut-setter with Fused Spade Handle

The following construction features are emphasized: The stators are secured to the field casing by multiple projecting keys integral with the stator, engaging with keyways in the field casing. This construction, in addition to providing a rigid mounting for the stator, produces a large number of channels for cooling air. The rotor contains solid copper rods welded to massive copper end plates—a mechanically rigid and electrically efficient construction.

Fusetrons or time lag fuses in the handle provide overload protection, safeguarding the tool from prolonged overloads, but permitting momentary excess current for starting or brief overloads. The field casing and handles are made from magnesium alloy, reducing the weight by one-third, as compared to aluminum. Parts subject to heavy wear, such as gear-cases, bearing plates, and clutch housings, are made from malleable iron. The parts of drills, nut-setters, and screwdrivers having the same size motor are interchangeable.

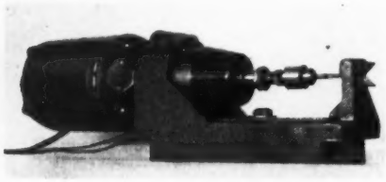
The entire line of nut-setters and screwdrivers is equipped with the new Rotor triple-action clutches, which assure uniform tension on nuts and screws. These clutches were described in the January number of

To obtain additional information about equipment described on this page, see lower part of page 512.

MACHINERY. The right-angle and special-angle attachments for drilling, screwdriving, and nut-setting are equipped with single positive clutches, single adjustable impact clutches, or double adjustable impact clutches, with a variety of drives. 101

Automatic Drilling Unit for Screw Machines

A compact self-contained unit adapted for use on screw machines and turret lathes for drilling cotter-pin or cross holes in studs or similar work will be exhibited at the coming Machine and Tool Progress Exhibition in Detroit, by the Hole Engineering Service, 307 Stormfeltz-Loveley Bldg., Detroit, Mich. In this drilling arrangement is incorporated a Govro-Nelson automatic drilling unit, which employs the principle of centrifugal force for obtaining feeding pressure, as described in February, 1938, MACHINERY, page 398.



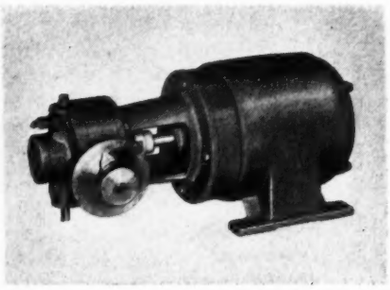
Drilling Unit with Automatic Feed for Use on Screw Machines

This unit is mounted on a special bracket, which includes a bushing support, in combination with a V-block stop. With this device, the cross-holes are drilled in the studs before they are threaded, thus avoiding burrs and a burring operation on both the hole and the thread.

With a suitable riser block, the assembly can be mounted on the screw machine cross-slide in line with the machine spindle, so that the V-block bushing support can be brought into contact with the work after the machine spindle is stopped. Pressure on a push-button switch causes the unit to feed the drill through the work and automatically return it to the starting point. The complete assembly, or the drilling unit only, is available. 102

Denison Variable-Volume Hydraulic Pump

A small variable-volume hydraulic pump which can be accurately controlled to a minimum of 5 cubic inches per minute has been placed on the market by the Denison Engineering Co., 236 N. Water St., Columbus, Ohio. This pump is designed for use where a slowly built-up, accurately controlled, high pressure is required. It is adapted for various types of testing machines, and is made in sizes suitable for the hydraulic circuits of machine tools. A rapid traverse or quick take-up is available, which allows the pump to deliver its maximum volume when it is not working against the load or is working only against a light predetermined load.

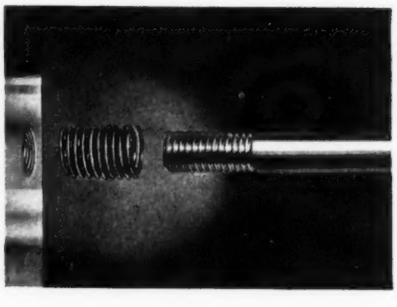


Variable-volume Hydraulic Pump Made by Denison Engineering Co.

The motor drives the pump through a standard flexible coupling. The pump is capable of continuous operation at a pressure of 1000 pounds per square inch, and of intermittent operation at a pressure of 2000 pounds per square inch. It is usually furnished integral with the motor, but is available with foot mountings, where required. It is also built in two volume capacities, of 100 cubic inches and 175 cubic inches. 103

"Aero-Thread" Screw Thread System

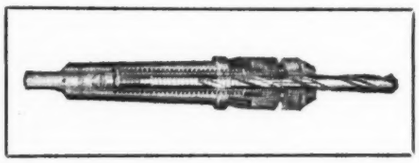
A screw thread system designated the "Aero-Thread," which represents a radical departure from existing screw thread systems, has been developed by Air Associates, Inc., Roosevelt Field, Garden City, N. Y.



"Aero-Thread" Screw and Insert Ready for Insertion in Tapped Hole

This system was developed primarily for use in the aircraft industry where high-strength studs and cap-screws are required. It has particular advantages when used in tapped holes in light alloys, such as aluminum or magnesium. The high strength of the Aero-Thread screw or stud also makes this system useful in machine construction where compactness and light weight are desirable.

The outstanding feature is the use of a spirally wound insert or bushing of precision-formed, high tensile strength, bronze spring wire. This insert, which is shown in the accompanying illustration, is fitted into the tapped hole by screwing it into the threads. The design of the insert is such that, while it can be readily screwed into place, it becomes a fixed part of the tapped hole. When the stud or cap-screw is assembled, it bears against and is in direct contact with the spiral bronze insert instead of with the softer metal of the light alloy part. 104



Scully-Jones Chuck with Drill Length Adjustment

Scully-Jones "Feed-As-You-Need" Chuck

A drill chuck with an unusual feature has been placed on the market by Scully-Jones & Co., 1901 S. Rockwell St., Chicago, Ill. It is known by the trade name "Feed-As-You-Need" chuck, because the construction allows the chuck to hold the drill within its body and feed it out by means of a screw arrangement. The operator needs to have only as much of the drill projecting as is necessary to pass through the work and drill bushing, thus reducing drill breakage to a minimum. In multiple-spindle machines, each drill can be adjusted to project the required distance from the spindle. This chuck can also be adapted for drilling, counterboring, and spot-facing to a given depth by proper adjustment of the tools. 105

* * *

It is estimated that $4,500,000,000 was spent in 1938 on automobile vacation travel.

To obtain additional information about equipment described on this page, see lower part of page 512.

What Were the Causes of the Depression?

NUMEROUS explanations have been given of the depression. Almost everybody has had an opinion to air on the subject. Many of these opinions have not been based on any profound study or been stated with any real regard for the facts. It is, therefore, of considerable interest and importance to be able to record the results of a careful study made by the National Association of Manufacturers, covering eighteen months of fact-finding studies. According to the Association, government, industry, and labor must all share the blame for the policies that retarded the recovery in the years 1932-1937, and that led to the second depression in 1937-1938. The report insists that these policies must be avoided if prosperity is to be regained.

While dwelling heavily upon government responsibility for retarding recovery and for the business decline beginning in 1937, the report shows great impartiality in pointing out the policies of business and labor that have been contributing factors.

The business policies that contributed to the depression are listed in the report as follows:

1. Mistaken inventory policies on the part of some industries, induced by the labor situation and fear of inflation; also lack of appreciation that while an increasing inventory may be necessary where sales are high, it should be in lower ratio to sales volume.

2. Unwise consumer credit policies of many companies, resulting in an increased volume of unsound installment selling.

3. Failure of many companies to improve their financial structure by reducing fixed charges; failure in many instances to avoid overcapitalization or financing with borrowed capital beyond ability to pay.

4. Too ready acceptance of apparent effects of government spending policies, and making business calculations thereon; in many instances, business deliberately sought government financial aid.

5. Failure in many instances to develop satisfactory labor relationships based on mutual respect and cooperation; failure in many instances where company policies were sound to convince workers that this was the case.

6. Failure of business to sell itself to the public, with explanation of its practices, obligations, and contributions to national improvement.

Turning to government policies and activities, the report lists the following as "specific factors that operated as continuing, cumulative, and combined depressive elements":

1. Continued reliance upon the theory that purchasing power can be created or maintained by artificially fixing prices or by the artificial support of wage rates, both without reference to the output of goods and services.

2. Excessive, unsound, and frequently unfairly administered taxes.

3. Unsound regulation of business, with particular reference to an attitude toward public utilities, which has enormously slowed up expansion in a vital part of our national economy; regulation of security financing, which has frequently operated to make financing difficult and expensive; and efforts to regulate agricultural production.

4. Uncertainties created by frequent expressions of public officials voicing hostile attitude toward business and investors.

5. An unsound relief program which removed administration from those most familiar with the particular problems involved; continued "made work" efforts which undermined morale of recipients and destroyed the respect of the taxpayers. "Although a public works program in time of depression is in theory a sound economic concept, and might be of substantial benefit, the program as carried out has been ineffective and frequently wasteful in practice," the committee asserted in touching on this point.

6. Labor unrest resulting from the government's labor policy, including the "false" assumption that employer-employe relations must lead to inevitable conflict, and "largely one-sided and biased" administration of the National Labor Relations Act.

7. The theory that the government should control through taxes and regulation the flow of funds into private industry—both as to amount, purpose, and place of investment.

8. Government price policies—efforts to intervene in general prices by controlling price levels through use of the Federal monetary, credit, and banking systems, and efforts to influence directly commodity prices.

9. Continuing and increasing government competition, and threats of competition, with private business.

10. Government policies which cause a fear of inflation.

11. Inconsistency of many government methods.

12. Uncertainty as to the continuance at any time of existing government methods, and what might be proposed next.

"The cumulative effect of these government policies," according to the committee report, "undermined confidence in the American economy and restricted the 1932-1937 recovery, with the result that the 1937-1938 depression started from a much lower level than the nation's past economic history would have led us normally to expect, and extended to greater depths than would otherwise have been the case."

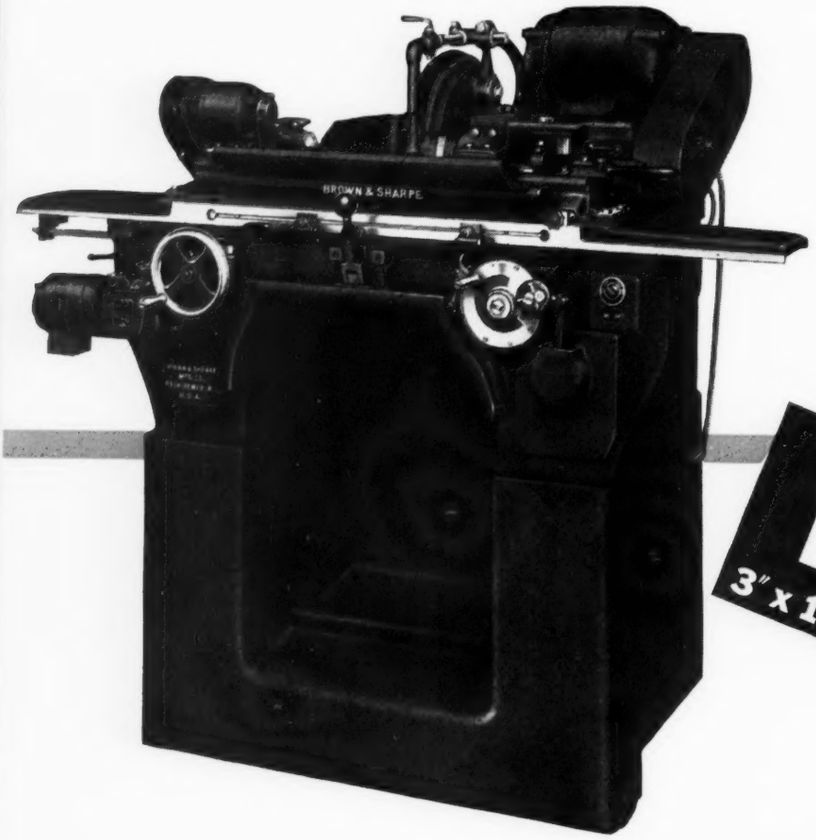
The contributing factors for which labor was responsible were especially the increasing number and severity of strikes, the insistence on wage rates not related to productivity or selling prices to consumers, and the breaking of labor agreements.

In this connection, it is especially pointed out that the economic collapse in 1937, continuing into 1938, was largely precipitated by developments in the labor field, including sit-down strikes with deliberate and illegal seizure of the property of others as a means of enforcing demands; failure of the Federal government and many state governments to protect private property, as well as indications on the part of the government that seizure of property by sit-down strikers might be lawful.

* * *

The Bolt and Nut Industry

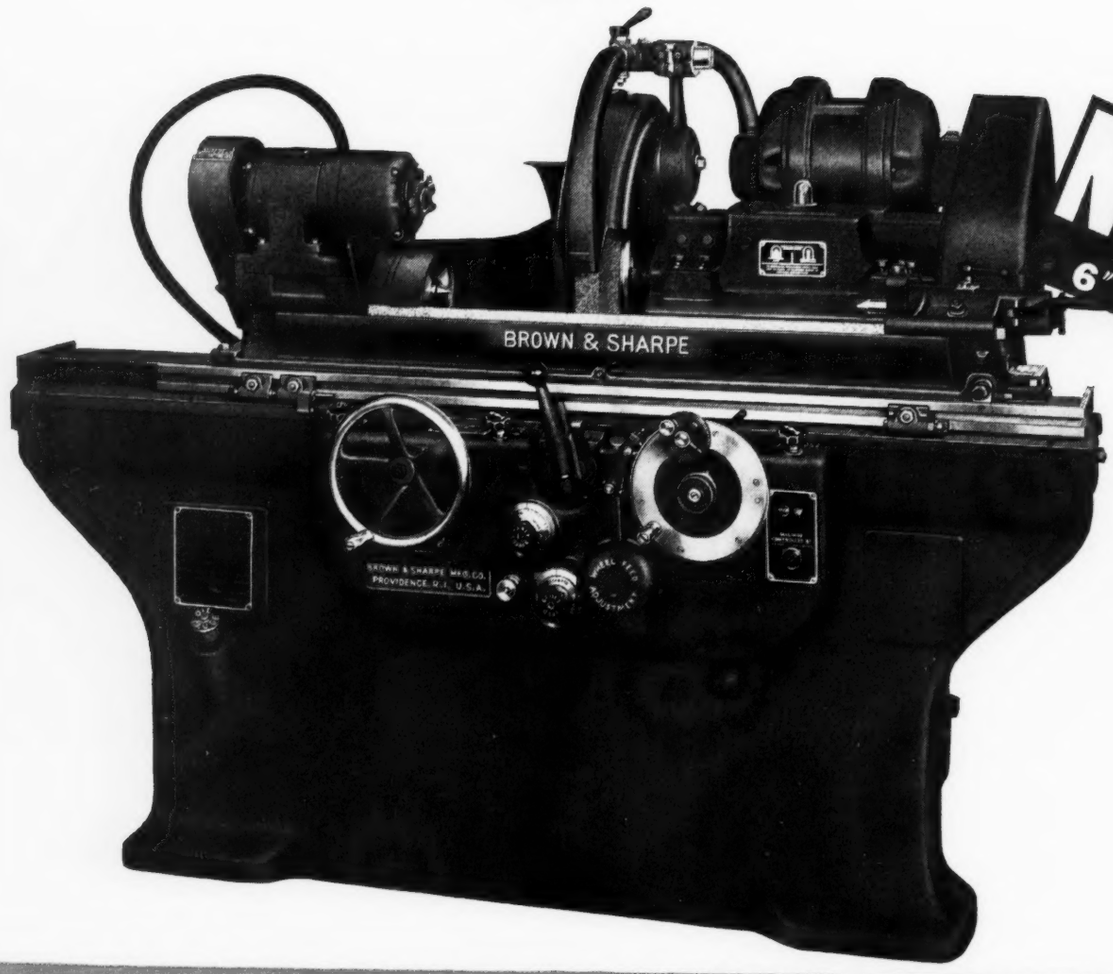
The industry manufacturing bolts, nuts, washers, and rivets is one of the larger of the metal products industries. According to statistics published by the Bureau of the Census, Washington, D. C., there were 138 plants engaged in the manufacture of bolts, nuts, washers, and rivets in the United States in 1937. The total value of the product of the industry was slightly over $98,000,000. The industry paid for materials and supplies, fuel, and electric energy over $44,000,000. It paid over $22,000,000 in wages; the average number of wage-earners employed was 16,840. In addition to these expenditures, the amount paid out by the industry for power produced in the owner's own plant, interest, rent, depreciation, taxes, insurance, and advertising ran into large figures.



Three Types Seven Sizes

No 5
3" x 12" 3" x 18"

. . . a small machine for fast production of small parts. Recessed base permits operator to sit at machine with all controls handy.



Nos 10-12
6" x 18" 6" x 30"

Electric-Hydraulic Type

. . . for small and medium size parts. Simple hydraulic and electrical controls—all grouped at front.

B·S

Ask for Complete Specifications

Brown & Sharpe Mfg. Co.
Providence, R. I., U. S. A.

BROWN &

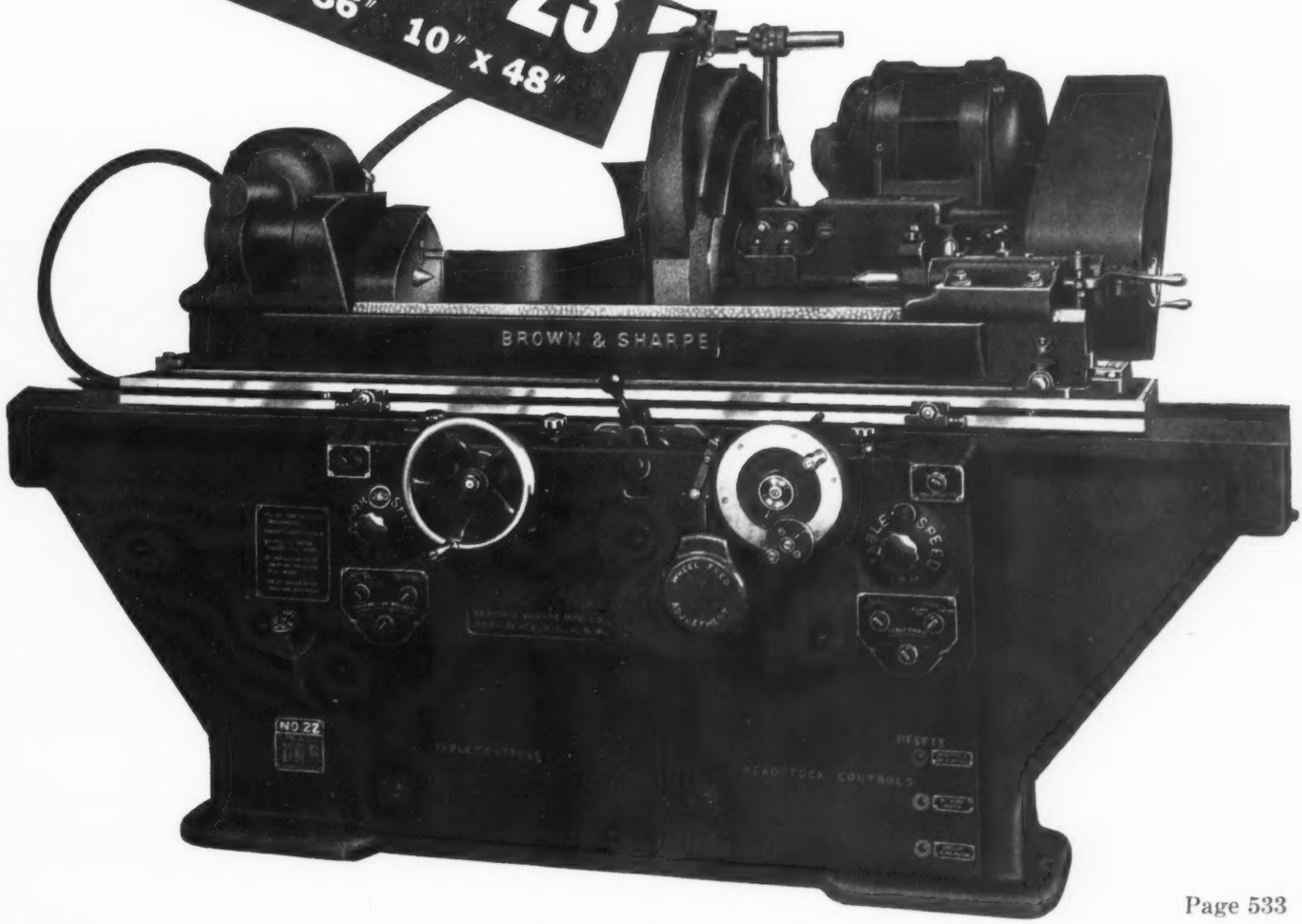
PRODUCTIVE
PLAIN GRINDING MACHINES
for High Accuracy and Fine Finish —

Nos 20-22-23

10″ x 18″ 10″ x 36″ 10″ x 48″

Electrically Controlled

. . . powerful production units — with new time- and labor-saving features through flexibility of the electrical control.



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SHARPE

NEWS OF THE INDUSTRY

Foreign

AUSTRALIAN ABRASIVES PTY., LTD., a new company formed to produce grinding wheels and allied abrasive and refractory products, is erecting a plant on a four-acre tract in the industrial district of Sydney, New South Wales. The following companies are cooperating with the new Australian company: Carborundum Co., Niagara Falls, N. Y.; Norton Co., Worcester, Mass.; Universal Grinding Wheel Co., Ltd., Stafford, England; and McPherson's Pty., Ltd., Australia.

Illinois

GENERAL ELECTRIC CO., Schenectady, N. Y., has purchased 77,000 square feet of land for the erection of a modern building to house the company's Chicago headquarters. An expenditure of approximately $2,500,000 is involved in the project. The new building will occupy the block bounded by S. Canal, S. Clinton, W. Cabrini, and W. Arthington Sts.

WHEELCO INSTRUMENTS CO., 1933 S. Halsted St., Chicago, Ill., has appointed C. W. LUGAR representative in the Indianapolis territory. Mr. Lugar will be located at 216 Indianapolis Terminal Warehouse, Indianapolis, Ind.

W. H. JOHNSON, formerly purchasing agent of the Climax Engineering Co., Clinton, Iowa, has been appointed purchasing agent of Foote Bros. Gear & Machine Corporation, Chicago, Ill.

LAKE ERIE ENGINEERING CORPORATION, Buffalo, N. Y., manufacturer of hydraulic presses, has appointed L. E. PECK, 1540 E. 53rd St., Chicago, Ill., midwest district sales manager.

VAN NORMAN MACHINE TOOL CO., Springfield, Mass., has appointed the MARSHALL & HUSCHART MACHINERY CO., Chicago, Ill., exclusive representative in the Chicago territory for Van Norman machine tools.

Michigan

CARBOLOY CO., INC., 2985 E. Jefferson Ave., Detroit, Mich., will enlist the cooperation of forty-seven small tool manufacturers in connection with its display at the Machine, Tool, and Progress Exhibition at Convention Hall in Detroit, March 14 to 18, where a wide range of tools will be shown, as well as a large collection of photographs indicating the tooling of Carboloy on thirty-one different types of machines. Special non-cutting, wear-resistant applications of Carboloy-tipped parts, such as textile guides, centerless grinder rests, lathe and grinder centers, etc., will also be shown.

UDYLITE CORPORATION, Detroit, Mich., a newly formed organization which has taken over the business and assets of the former UDYLITE CO., has acquired all the capital stock of the BRIGHT NICKEL CORPORATION, of Detroit, owner of the basic Schlotter patents covering the bright nickel-plating process. The Bright Nickel Corporation will be operated as a wholly owned subsidiary of the Udylite Corporation. The officers of the new corporation are Charles Awkermann, chairman of the board; L. K. Lindahl, president; C. H. Reeme, vice-president; and Horace Maynard, secretary.

GEORGE R. SCOTT, president of the Cone Worm Gear Corporation and gear consultant of the Michigan Tool Co., Detroit, Mich., addressed a meeting of the Association of Iron and Steel Engineers held in Detroit on February 14 on the subject "The Evolution of Worm Gearing, Culminating in the Cone Design."

ALBERT E. HACKETT, formerly with the Thomson-Gibb Electric Welding Co., Lynn, Mass., has joined the Progressive Welder Co., Detroit, Mich., in an executive capacity. Mr. Hackett has been connected with the welding field for nearly thirty years.

New England

AMERICAN CHAIN & CABLE CO., INC., Bridgeport, Conn., announces that R. E. GREENWOOD has been appointed district sales manager of the Chicago territory of the American Chain Division of the company, with headquarters at 400 W. Madison St., Chicago, Ill., succeeding G. B. KUTZ, who has been transferred to York, Pa., as assistant to the general manager of sales. R. C. BRENIZER has been appointed Philadelphia district sales manager, with headquarters at Second and Diamond Sts., Philadelphia, Pa., succeeding Mr. Greenwood.

W. D. ENDRES has been appointed sales manager of the Billings & Spencer Co., Hartford, Conn., manufacturer of forged tools. He will be in charge of the merchandise tool division, succeeding W. ROY MOORE, who recently resigned. Mr. Endres, who is a graduate of the Northwestern University, has been divisional manager of the Billings & Spencer Chicago branch office and warehouse.

PRATT & WHITNEY, DIVISION NILES-BEMENT-POND CO., Hartford, Conn., has made plans for the erection of a new factory consisting of a one-story manufacturing building, a two-story office building, and a two-story pattern storage, with garage and power plant, covering a total amount of floor space of about 700,000 square feet. The construction of the buildings is to be started at once, and it is expected that the new plant will be ready for occupancy early next fall.

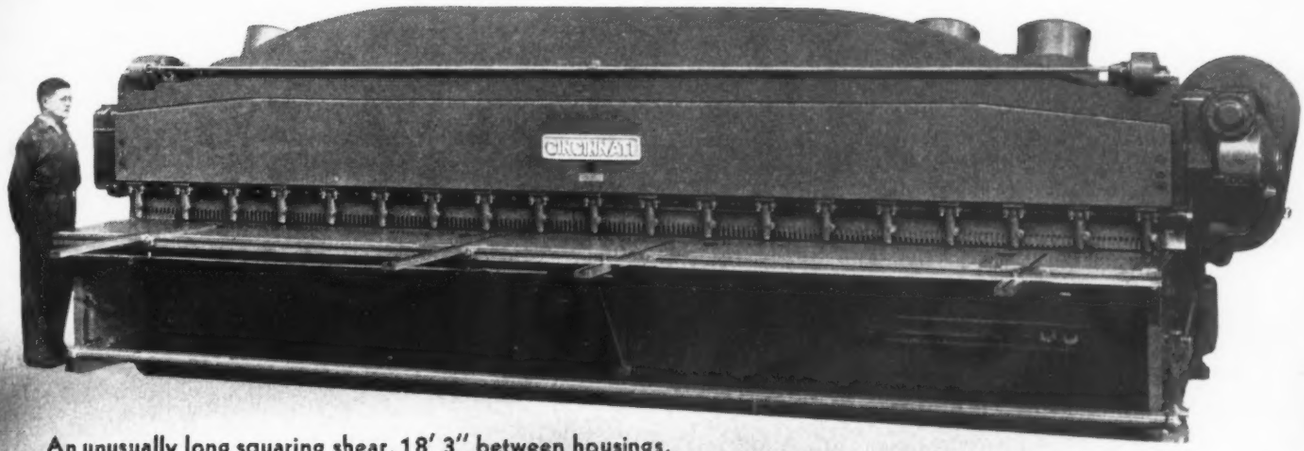
LESTER A. LANNING, chief metallurgist of the New Departure Division of the General Motors Corporation, Bristol, Conn., has been made assistant plant manager. Mr. Lanning was formerly superintendent of the Heat Treating Division. JOHN C. KIELMAN succeeds Mr. Lanning as superintendent of the Heat Treating Division, of which he was formerly assistant superintendent.

BRIDGEPORT PATTERN & MODEL WORKS, 52 Remer St., Bridgeport, Conn., announces that the name of the firm has been changed to BRIDGEPORT MACHINES, INC. This change was made because of the fact that the company has discontinued its pattern division in order to devote its entire time to the production of milling equipment.

ARTHUR R. HEISE, for several years chief engineer of the William Schollhorn Co., New Haven, Conn., manufacturer of hand tool specialties, has been appointed general manager.

HENRY S. BEAL has become associated with the Heald Machine Co., Worcester, Mass., in the capacity of general manager. Mr. Beal was formerly president of the Sullivan Machinery Co., Chicago, Ill., and previous to that was manager

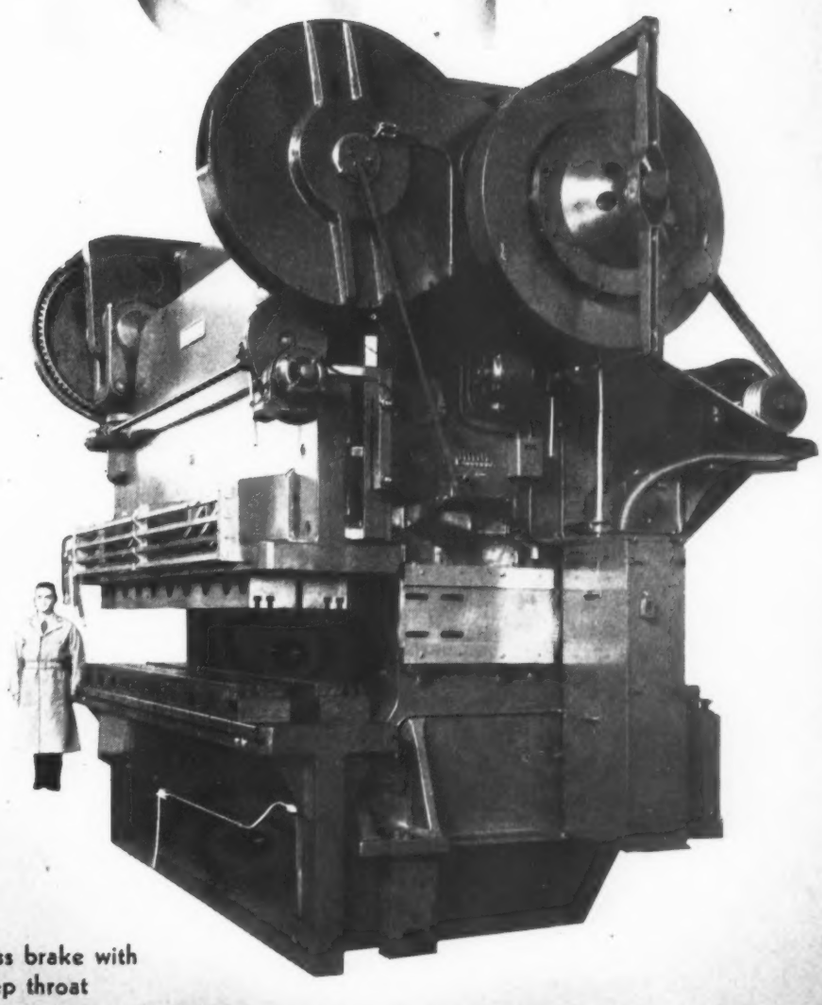
Henry S. Beal, New General Manager of the Heald Machine Co.



An unusually long squaring shear, 18' 3" between housings, particularly adapted to aircraft work

CAPACITY

For the long job • • • for the big job. Cincinnati Shears and Cincinnati Brakes have what it takes • • • speed • • • power • • • accuracy.



An exceptionally large press brake with high die space and deep throat

THE CINCINNATI SHAPER COMPANY, CINCINNATI, OHIO

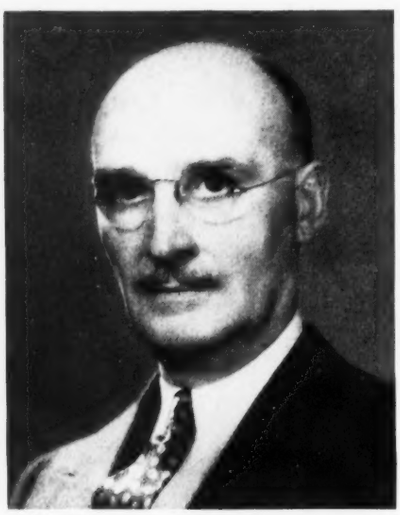
SHAPERS · SHEARS · BRAKES

of the Jones & Lamson Machine Co., Springfield, Vt. He is a past-president of the National Machine Tool Builders' Association.

E. O. BEHNE, formerly connected with the Defiance Machine Works, Defiance, Ohio, has entered the employ of the Reed-Prentice Corporation, Worcester, Mass., as chief engineer in charge of engineering and development. A. F. SCHOEPFLIN, who was connected with the Doehler Die Casting Co. for thirty years, is now consulting engineer with the Reed-Prentice Corporation, specializing in die-casting, including brass, aluminum, zinc, and magnesium.

New York

R. E. CHRISTIE, who has long been identified with the specialty steel business and has been connected with the Crucible Steel Company of America, 405



R. E. Christie, Recently Appointed Assistant to the President of the Crucible Steel Co. of America

Lexington Ave., New York City, for many years, has been made assistant to the president of the company, R. E. Desvernine.

LOUIS J. GALBREATH has been appointed technical advisor for the New York district sales division of Revere Copper & Brass, Inc. Mr. Galbreath will have headquarters at 75 E. 45th St., New York City. A graduate of Cornell, class of 1917, Mr. Galbreath has had wide experience in the non-ferrous metallurgical field. After graduation he was employed by the Mueller Brass Co., and helped to design that company's first copper tube mill at Port Huron. He became connected with Revere Copper & Brass, Inc., in 1935 as head of the company's product development department.

WILLIAM ABBETT LEWIS, JR., engineer with the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., and a Westinghouse lecturer in electrical engineering at the University of Pittsburgh, has been appointed director of the School of Electrical Engineering in the College of Engineering, Cornell University. Dr. Lewis is a graduate of the California Institute of Technology. He became connected with the Westinghouse organization in 1929.

REVERE COPPER & BRASS, INC., with headquarters at 230 Park Ave., New York City, has just completed a new brass and copper mill at Rome, N. Y., at a cost of $3,250,000. This is part of a huge modernization program carried out by the company during the last five years. Several millions have also been expended in the Revere plants in Chicago, Detroit, Baltimore, and New Bedford, Mass.

OAKITE PRODUCTS, INC., 22 Thames St., New York City, recently held, at the headquarters in New York, a two-day conference of division managers, at which new developments and improvements in cleaning methods, materials, and equipment were discussed. A subject of major interest related to machine shop practice—metal cutting and grinding, and the prevention of rusting of parts between operations.

FRANK J. HILL, for some years eastern sales representative of Greene, Tweed & Co., 109 Duane St., New York City, manufacturers of "Palmetto" and other brands of mechanical packing, has been made sales manager of the domestic division of the company's packing department.

REVERE COPPER & BRASS, INC., 230 Park Ave., New York City, has appointed KEITH C. BOWERS, formerly of the company's St. Louis office, as its sales representative in western Missouri and Kansas, with headquarters at 325 Ward Parkway, Kansas City, Mo.

LAMINATED SHIM CO., INC., Long Island City, N. Y., has recently celebrated its twenty-fifth anniversary. It was in December, 1913, that Carlton N. Aborn and several associates organized a company primarily to manufacture a newly invented laminated shim.

LOUIS M. GREENE has become assistant works manager, with direct supervision of production and personnel, of the two merged enterprises, the Pathe Engineering Co. and the Multi-Needle Engineering Co., Long Island City, N. Y.

J. H. WILLIAMS & Co., manufacturers of drop-forgings and drop-forged tools, have moved their New York office from 75 Spring St. to 225 Lafayette St., corner of Spring—a block distant from the former location.

Ohio and Indiana

L. R. KELLS has been appointed chief engineer of the Salem Engineering Co., Salem, Ohio. Mr. Kells, who graduated

L. R. Kells, Chief Engineer of The Salem Engineering Co.

from Ohio State University in 1914, has been closely associated with the industrial furnace industry for twenty years.

NATIONAL SCREW & MFG. CO., Cleveland, Ohio, announces that, at the recent annual stockholders' meeting, H. G. ALEXANDER was elected chairman of the board, and HERBERT P. LADDS, president and a director. Mr. Alexander has served as president since 1929. Mr. Ladds was formerly president of Sweet's Steel Co., Williamsport, Pa.

DINGLE-CLARK CO., Cleveland, Ohio, now represents the JOHN WALDRON CORPORATION, New Brunswick, N. J., in the sale of Waldron gear type flexible couplings, through its offices in Cleveland, Pittsburgh, and Philadelphia.

FREDERICK W. COPELAND, formerly president of the H. Channon Co., Chicago, Ill., has been elected president of the Sullivan Machinery Co., Michigan City, Ind.

Oregon and California

G. S. ROGERS & Co., 228 N. LaSalle St., Chicago, Ill., has appointed the PACIFIC MACHINERY & TOOL STEEL CO., Portland, Ore., distributor in the northwestern states for G-S-R specification products used in the heat-treatment and finishing of steel. Rex DeLong will head the newly created Processing Materials Division of the Pacific Machinery & Tool Steel Co. Mr. DeLong was formerly northwest sales manager of E. F. Houghton & Co.

"CATERPILLAR" FACTORY

takes advantage of the New

2½' ARM SUPER-SERVICE RADIAL

This factory action photograph shows the popular 2 1/2' Arm Super-Service Radial used at the "Caterpillar" Plant to ream dowel holes and to tap holes in the straight side of four-cylinder, 3 3/4" bore cylinder blocks. Note that the column of this Super-Service Radial is mounted directly on the fixture, which is but one example of the practicability of this efficient machine tool. The advantages of size, economy, ease of handling and floor space requirements are apparent. Additional advantages include—simplified head, pick-off gears, automatic oiling, multiple splined integral key shafts, 3 rates of power feed controlled by single lever, 3 or 6 spindle speeds and many others.

FULL PARTICULARS AND BULLETIN UPON REQUEST

RADIAL AND UPRIGHT DRILLING MACHINES

SUPER SERVICE

THE CINCINNATI BICKFORD TOOL CO. OAKLEY, CINCINNATI, OHIO, U.S.A.

FRAY-MERSHON, INC., Glendale, Calif., manufacturer of precision tools, has appointed W. W. BRAZIER CO., Los Angeles, Calif., exclusive factory representative for the firm's line of Defiance and "All-Angle" vises.

Pennsylvania

L. B. MCCULLY, who, in 1916, as a young engineering student, enrolled in the apprentice course of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., recently became manager of the Transportation and Generator Division of the company, succeeding F. H. STOHR, who has been made manager of the industry sales department. JOHN S. DEAN, one of the most widely known transportation maintenance engineers in the country, has retired from the Westinghouse organization after thirty-six years of service.

C. W. HEPPENSTALL, since 1920 president and treasurer of the Heppenstall Co., Pittsburgh, Pa., has become chairman of the board of directors, and R. B. HEPPENSTALL, formerly vice-president and general manager of sales, has been elected president. C. W. Heppenstall has been with the company for forty-six years, and is of the fourth generation of Heppenstall steelmakers, who have been associated with that industry in England and America for 147 years.

AMERICAN FLEXIBLE COUPLING CO., Erie, Pa., has appointed the INDUSTRIAL SALES & ENGINEERING CO., 3118 N. Broad St., Philadelphia, Pa., Philadelphia district sales representative for the territory comprising southeastern Pennsylvania, New Jersey, and eastern Maryland. The company has also appointed M. H. JEWETT, Room 301, Union Bldg., 1836 Euclid Ave., Cleveland, Ohio, Cleveland district sales representative for the northern Ohio territory.

ARTHUR J. WILLIAMSON has joined the technical staff of the Summerill Tubing Co., Bridgeport, Pa., as metallurgical engineer in charge of research and development. Mr. Williamson is a graduate of Lehigh University. For the last four years, he has been research metallurgist for the John A. Roebling's Sons Co., Trenton, N. J.

HOOPES, CUNNINGHAM & MCKINNEY, industrial design consultants, have recently enlarged their staff and removed their offices to 12 S. Twelfth St., Philadelphia, Pa. The services of this group include the design of industrial and technical products from the standpoint of both function and appearance.

LUKENS STEEL CO., Coatesville, Pa., at its recent annual meeting of stockholders, re-elected the following officers: President, ROBERT W. WOLCOTT; vice-presidents, CHARLES L. HUSTON, F. H. GORDON, and D. S. WOLCOTT; secretary, STEWART HUSTON; and treasurer, J. W. HERMAN.

W. A. HUBER has been appointed manager of sales of the Gilmore Wire Rope Division of the Jones & Laughlin Steel Corporation, Pittsburgh, Pa. Mr. Huber has been with the Jones & Laughlin organization since 1936.

Wisconsin

D. J. MURRAY MFG. CO., Wausau, Wis., has purchased the manufacturing rights to the power-driven forge hammer made and sold for many years as the Mayer-Moloch hammer. In the future, this machine will be manufactured as the Murray hammer. These hammers are made in five sizes, from 25- to 500-pound ram capacity.

LOUIS W. FALK has been appointed executive engineer of the Falk Corporation, Milwaukee, Wis. W. P. SCHMITTER has been appointed chief engineer. HAROLD S. FALK, vice-president, continues in his present capacity as director of engineering.

INDUSTRIAL CLUTCH CO., Waukesha, Wis., elected the following officers at its annual meeting: President, C. M. EASON; treasurer, E. R. ESTBERG; and secretary, JOHN J. PFEFFER.

OBITUARIES

William P. Bradbury

William P. Bradbury, vice-president and general sales manager of the Consolidated Ashcroft Hancock Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn., died of pneumonia after a six-day illness, January 14, at the age of fifty-three years.

Mr. Bradbury joined Manning, Maxwell & Moore in 1902 as an office boy. He advanced step by step, holding various positions in the sales department. Gradually his work took him to every part of the United States and to several foreign countries. In 1923, he became general sales manager, and in 1930, vice-president in charge of sales, which position he held until his death.

Mr. Bradbury's sales activities covered a wide range. During the last twenty-five years there has scarcely been a public utility or other major power plant built, in connection with which he has not rendered service. He numbered among his friends hundreds of distributors and their salesmen, and was esteemed for his sympathetic understanding and kindly attitude toward all those with whom he came in contact.

COMING EVENTS

MARCH 8-10—Thirty-ninth convention of the INTERNATIONAL ACETYLENE ASSOCIATION at the Rice Hotel, Houston, Tex. For further information, address International Acetylene Association, 205 E. 42nd St., New York City.

MARCH 14-18—Annual meeting and MACHINERY AND TOOL PROGRESS EXPOSITION OF THE AMERICAN SOCIETY OF TOOL ENGINEERS at Detroit, Mich. Further information can be obtained from the executive secretary, Ford R. Lamb, 2567 W. Grand Blvd., Detroit, Mich.

MARCH 27-29—Tenth annual convention of the GREATER NEW YORK SAFETY COUNCIL at the Hotel Pennsylvania, New York City. For further information, address Greater New York Safety Council, Room 3615, Lincoln Bldg., New York City.

APRIL 18-20—Fourth annual MACHINE TOOL ELECTRIFICATION FORUM, to be held at the Westinghouse Electric & Mfg. Co.'s plant, East Pittsburgh, Pa.

MAY 15-18—Annual convention of the AMERICAN FOUNDRYMEN'S ASSOCIATION in Cincinnati, Ohio. C. E. Hoyt, executive vice-president, 222 W. Adams St., Chicago, Ill.

MAY 22-24—Annual meeting of the AMERICAN GEAR MANUFACTURERS ASSOCIATION at Hotel Cavalier, Virginia Beach, Va. J. C. McQuiston, manager-secretary, 602 Shields Bldg., Wilkinsburg, Pa.

MAY 22-JUNE 8—WORLD AUTOMOTIVE ENGINEERING CONGRESS to be held in New York, Indianapolis, Detroit, and San Francisco under the auspices of the Society of Automotive Engineers. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

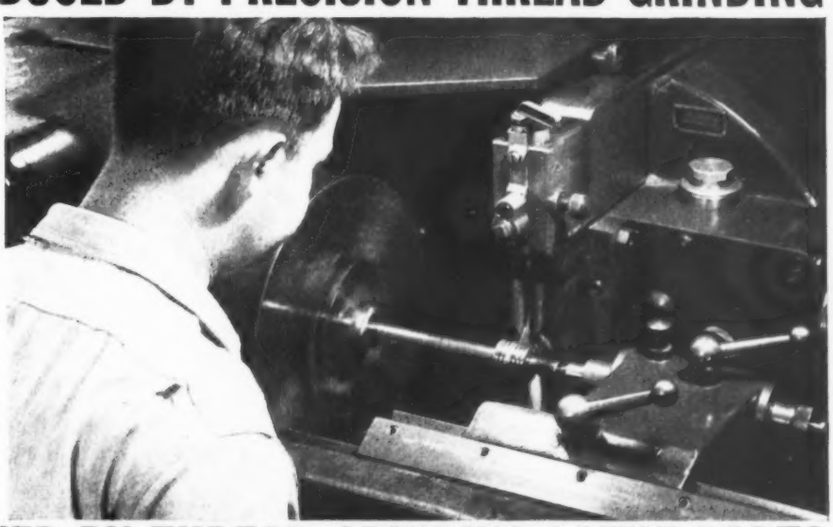
JUNE 25-JULY 1—THIRTEENTH INTERNATIONAL CONGRESS OF CARBIDE, ACETYLENE, OXY-ACETYLENE WELDING AND ALLIED INDUSTRIES, to be held in Munich, Germany. For further information, address the International Acetylene Association, 30 E. 42nd St., New York City.

JUNE 26-30—Forty-second annual meeting and fifth EXHIBIT OF APPARATUS AND INSTRUMENTS of the AMERICAN SOCIETY FOR TESTING MATERIALS at Chalfonte-Haddon Hall, Atlantic City, N. J. For further information, address Secretary,

THREAD GRINDING OFFERS YOU NEW SAVINGS

● To obtain the required accuracy and finish on stressed threaded parts, an aircraft engine manufacturer is using seven Ex-Cell-O Precision Thread Grinders as shown at the right. Not only are parts formerly thread milled now thread ground after hardening at comparable cost and output, but service failures have actually been reduced.

SERVICE FAILURES REDUCED BY PRECISION THREAD GRINDING



● Production savings ranging up to about 50% on chuck collet hoods with internal threads and 75% on worms with external threads, have been made on miscellaneous lathe parts by a machine tool builder with the Ex-Cell-O Universal Precision Thread Grinder at the right. Grinding after hardening also eliminates errors caused by distortion.

AS MUCH AS 75% SAVED BY THREAD GRINDING LATHE PARTS

661
SEPT
13
● If you are interested in saving money with Ex-Cell-O Precision Thread Grinders, write today for complete information. Catalog No. 1168

● All threaded parts are now ground from the solid, after hardening, by a manufacturer of airplane landing gear struts. With the Ex-Cell-O Universal Precision Thread Grinders at the right, machining time has been reduced 50%, rejections are almost eliminated, assembly is faster and a stronger fit is secured between mating parts.

MACHINING AND ASSEMBLY TIME CUT—PRODUCT IMPROVED

EX-CELL-O CORPORATION • 1200 OAKMAN BLVD. • DETROIT, MICHIGAN

American Society for Testing Materials, 260 S. Broad St., Philadelphia, Pa.

JULY 10-14—Semi-annual meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at San Francisco, Calif. Clarence E. Davies, secretary, 29 W. 39th St., New York City.

SEPTEMBER 4-8—Fall meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at the Engineering Societies Bldg., 29 W. 39th St., New York City. CLARENCE E. DAVIES, secretary, 29 W. 39th St., New York City.

OCTOBER 15-21—Fortieth annual NATIONAL AUTOMOBILE SHOW, to be held at the Grand Central Palace, New York City. For further information, address the Automobile Manufacturers Association, General Motors Bldg., Detroit, Mich.

OCTOBER 23-27—NATIONAL METAL EXPOSITION to be held in conjunction with the annual meeting of the AMERICAN SOCIETY FOR METALS in the International Amphitheater, Chicago, Ill. W. H. Eisenman, secretary, American Society for Metals, 7016 Euclid Ave., Cleveland, Ohio.

* * *

A Labor Union Official on the Economic Basis of Labor Organizations

Two guiding principles that have always been at the foundation of the American labor movement must be thoroughly understood. The first is a firm belief in our present system—the system of individual initiative and private enterprise with its profit motive, always, however, with the understanding that labor must receive its fair share of the profits of production and distribution, and that the consumers shall benefit likewise in the form of reduced prices.

The second is that the American worker does not want to be supported by governmental relief payments any more than he desires to be supported by his neighbors, organized charity, or by standing in a bread-line. What he wants is an honest job in private industry with wages, hours and working conditions which will give him and his family the standard of living to which he is entitled. To obtain these, he knows that industry must be encouraged by government, and not penalized simply because it happens to be successful. He knows that it must continue to grow and expand if he is to be secure in his job and grow with it.

Relief we must have regardless of the cost when people are out of work and they and their families are hungry. But relief makes no contribution to the solution of the unemployment problem.—*Matthew Woll, vice-president, American Federation of Labor, in the Greenwich Time.*

NEW BOOKS AND PUBLICATIONS

THOMAS' REGISTER OF AMERICAN MANUFACTURERS (1939). 4600 pages, 9 by 14 inches. Published by the Thomas Publishing Co., 461 Eighth Ave., New York City Price, $15.

This well-known reference book—one of the most complete reference guides for buyers of all classes of machine equipment, tools, supplies, and manufactured goods in general—now in its twenty-ninth edition, is divided into four principal sections, each a complete directory in itself. The first and main section alone covers some 3615 pages, giving the manufacturers of each product arranged by states and cities. This section alone covers some 3615 pages. Then follows a section listing alphabetically, by states and cities, the representative banks in the United States and its possessions, together with a list of important commercial organizations, classified in the same manner.

The third section, covering some 425 pages, lists alphabetically all manufacturers and important dealers throughout the United States. In connection with each manufacturer's name is given his complete address, in addition to branch offices, subsidiaries, successors, etc. The names of individual officers are shown in many instances. For example, this section will answer such questions as "Where is the home office or the nearest branch of the Brown & Black Mfg. Co.?" "Who succeeded the Brown Axe & Tool Co.?" "What concerns are subsidiaries or affiliated with the General Motors Corporation?"

Finally, the fourth section, comprising 375 pages, contains an unusually complete list of American trade names, arranged alphabetically, giving the kind of product known by the trade name, as well as the manufacturer's name and address. The index is not limited to registered trade names. Possibly the majority of the trade names listed are not registered, so that products that are simply generally known to the trade by a certain name can be located in this index.

This reference work should be particularly useful to buyers of equipment and supplies of every description, since it gives unusually complete listings answering the question, "Who makes what?" It is also a directory of the different fields of industry, as well as a complete directory of all manufacturing concerns in the United States.

PLASTIC WORKING OF METALS AND POWER PRESS OPERATIONS. By E. V. Crane. 450 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York City. Price, $5.

This is the second edition of the author's well-known book on the production in large quantities in power presses. In preparing the second edition, the details of the plastic working theory have been clarified and explained, and practical details have been added with regard to several groups of operations. A chapter has been included discussing the mechanical characteristics and the utility of different types of metal-working presses. Another new chapter is devoted to an analysis of the means of combining operations in tooling automatically fed presses. Tabular data of use to press and die men, and a compilation of physical properties of frequently used metals, have been added. This new edition will doubtless be favorably received by the increasing number of engineers who find it necessary to obtain a thorough knowledge of pressed metal-working processes.

U.S.S. CARILLOY STEELS. 214 pages, 6 by 9 inches. Published by the Carnegie-Illinois Steel Corporation, 208 S. LaSalle St., Chicago, Ill. Price, $1.

This book may well be called a handbook on alloy steels. It contains a list of the elements entering into steel, their commercial uses, and their effect on the steel. A complete list of S A E alloy steels is included, giving analyses and commercial applications. Complete information is included on the hardening of steel, based on recent work performed at the laboratories of the Carnegie-Illinois Steel Corporation. The chapters on hardening and annealing give details on heating practice, heating furnaces, and quenching media. The physical properties of different grades of alloy steels after quenching in various ways are recorded. The book is profusely illustrated with charts. The important methods in steel-making practice are also illustrated by halftone engravings.

OXY-ACETYLENE WELDING. By Robert J. Kehl; revised by Morgan H. Potter. 130 pages, 5 1/2 by 8 1/2 inches. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. Price, $1.25.

This book has been thoroughly revised and enlarged by the instructor in charge of welding of the William Hood Dunwoody Industrial Institute of Minneapolis, Minn. It contains definite instructions on the procedure to follow in oxy-acetylene welding, including information on hard surfacing, lead burning and cutting. The contents and scope are such as to be of value not only to the apprentice, but also to the man with wider experience. It is suitable both for home study and class-room use.